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IMAGE GENERATION SYSTEM AND INFORMATION STORAGE MEDIUM

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Abstract of **JP2002183753**

PROBLEM TO BE SOLVED: To provide an image generation system and an information storage medium, capable of generating an image focused such as a visible image in the real world with a small processing burden. SOLUTION: When an original image is set as a texture, and texture mapping of the texture is executed by a bilinear filter system, texture coordinates are shifted by values smaller than one texel to generate a blurred image. The texture coordinates are shifted by the values smaller than one texel to generate the blurred image of the original image. After the texture coordinates are shifted to a first shift direction, and texture mapping is executed by a texel interpolation system, the texture coordinates are shifted to a second shift direction, and the texture mapping is executed by the texel interpolation system. Each &alpha value of each pixel is set according to a Z value of each the pixel of the original image, and the original image and the blurred image are &alpha -blended on the basis of the set &alpha values.

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CLAIMS

[Claim(s)]
[Claim 1]An image generation system characterized by comprising the following for generating a picture.
A means to map a texture in an object with a texel interpolation system.
A means to shift a texture coordinate of an object and to generate a shading-off picture of a source image when a source image is set up as a texture and this texture is mapped in an object with a texel interpolation system.

[Claim 2]An image generation system only a value smaller than 1 texel shifting a texture coordinate, and generating a shading-off picture of a source image in claim 1.
[Claim 3]An image generation system shifting a texture coordinate to the 2nd shift direction, and performing texture mapping with a texel interpolation system after it shifts a texture coordinate to the 1st shift direction and a texel interpolation system performs texture mapping in claim 1 or 2.
[Claim 4]An image generation system characterized by said object being a virtual object which has a shading-off field and identical shape in either of claims 1 thru/or 3.
[Claim 5]Either characterized by comprising the following of claims 1 thru/or 4.
An alpha value setting-out means to set alpha value of each pixel as a value according to a depth value of each pixel of a source image.
A means of which alpha composition is done so that a source image and a shading-off picture of this source image may be obscured according to a depth value based on alpha value set as each pixel and compositing ratio of a picture may change.

[Claim 6]An image generation system by which the feature of setting up alpha value of each pixel is carried out in claim 5 as a pixel in which a difference of a depth value of a focus of a virtual camera and a depth value of each pixel is [the aforementioned alpha value setting-out means] large so that compositing ratio of a shading-off picture may become high.
[Claim 7]An image generation system controlling the range of depth of field, or strength of a shading-off effect by changing correspondence relation between a depth value of each pixel, and alpha value to variable in claim 5 or 6.
[Claim 8]In either of claims 5 thru/or 7, the aforementioned alpha value setting-out means sets the alpha value as alpha 1 about a pixel which has the depth value between Z1 and Z2, and the alpha value is set as alpha 2 about a pixel which has the depth value between Z2 and Z3. ...., an image generation system setting the alpha value as alphai about a pixel which has the depth value between Zi and Zi+1.
[Claim 9]An information storage medium used for an image generation system for generating a picture, comprising:
A means to map a texture in an object with a texel interpolation system.
A means to shift a texture coordinate of an object and to generate a shading-off picture of a source image when a source image is set up as a texture and this texture is mapped in an object with a texel interpolation system.

A program for realizing an image generation system.

[Claim 10]An information storage medium only a value smaller than 1 texel shifting a texture coordinate, and generating a shading-off picture of a source image in claim 9.
[Claim 11]An information storage medium shifting a texture coordinate to the 2nd shift direction, and performing texture mapping with a texel interpolation system after it shifts a texture coordinate to the 1st shift direction and a texel interpolation system performs texture mapping in claim 9 or 10.
[Claim 12]An information storage medium characterized by said object being a virtual object which has a shading-off field and identical shape in either of claims 9 thru/or 11.
[Claim 13]Either characterized by comprising the following of claims 9 thru/or 12.
An alpha value setting-out means to set alpha value of each pixel as a value according to a depth value of each pixel of a source image.
A means of which alpha composition is done so that a source image and a shading-off picture of this source image may be obscured according to a depth value based on alpha value set as each pixel and compositing ratio of a picture may change.
A program for realizing an image generation system.

[Claim 14]An information storage medium with which the feature of setting up alpha value of each pixel is carried out in claim 13 as a pixel in which a difference of a depth value of a focus of a virtual camera and a depth value of each pixel is [the aforementioned alpha value setting-out means] large so that compositing ratio of a shading-off picture may become high.
[Claim 15]An information storage medium controlling the range of depth of field, or strength of a shading-off effect by changing correspondence relation between a depth value of each pixel, and alpha value to variable in claim 13 or 14.
[Claim 16]In either of claims 13 thru/or 15, the aforementioned alpha value setting-out means sets the alpha value as alpha 1 about a pixel which has the depth value between Z1 and Z2, and the alpha value is set as alpha 2 about a pixel which has the depth value between Z2 and Z3. An information storage medium setting the alpha value as alphai about a pixel which has .... and its depth value between Zi and Zi+1.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to an image generation system and an information storage medium.
[0002]
Background Art and Problem(s) to be Solved by the Invention]Before, the image generation system which generates the picture which is in sight from the given viewpoint in the object space which is virtual three-dimensional space is known, and it is popular as what can experience what is called virtual reality. If the image generation system which can enjoy a racing game is taken for an example, a player will operate a car (object), and will be run a car in object space, and a three-dimensional game will be enjoyed by competing with the car which other players and computers operate.

[0003]Now, the picture generated by the conventional image generation system was not a picture by which focusing was carried out according to the distance from a viewpoint like human being's view image. For this reason, it had become expression as if it focused all the photographic subjects within a picture.

[0004]However, since the picture focused on all the photographic subjects from point-blank range to a long distance was a picture which cannot be seen in everyday life, appearance had unnaturalness.

[0005]In order to pursue a reality more, it is desirable to generate the picture by which the degree of the focus was adjusted according to distance, a sight line direction, etc. of a viewpoint and an object. However, distance with a viewpoint, etc. are calculated about each object in game space, and a processing load will become excessive if the blurred picture is generated by fading for every object and calculating condition.

[0006]In the image generation system which needs to generate the picture corresponding to the viewpoint which changes to real time using the restrained hardware resources, it becomes an important technical problem how the picture by which are few processing burdens and focusing was carried out like the view image of the real world is generated.

[0007]This invention is made in view of the above technical problems, and there is a place made into the purpose in providing the image generation system and information storage medium which can generate the picture by which focusing was carried out like the view image of the real world by few processing burdens.

[0008]
[Means for Solving the Problem]In order to solve an aforementioned problem, this invention is characterized by that an image generation system for generating a picture comprises:
A means to map a texture in an object with a texel interpolation system.
A means to shift a texture coordinate of an object and to generate a shading-off picture of a source image when a source image is set up as a texture and this texture is mapped in an object with a texel interpolation system.
An information storage medium concerning this invention includes a program for being an usable information storage medium and performing the above-mentioned means by computer. A

program concerning this invention contains a manipulation routine for being an usable program (a program embodied by subcarrier is included), and performing the above-mentioned means by computer.
[0009]According to this invention, a texel interpolation system is used effectively, it obscures by simple processing, and a picture can be generated now.
[0010]A texel interpolation system is a method etc. which interpolate picture information of texel and obtain picture information of a pixel although limitation in particular is not carried out, for example, there are a bilinear filter method, a try linear filter method, etc.
[0011]Only a value smaller than 1 texel shifts a texture coordinate, and an image generation system, an information storage medium, and a program concerning this invention generate a shading-off picture of a source image.
[0012]An image generation system, an information storage medium, and a program concerning this invention, After it shifts a texture coordinate to the 1st shift direction and a texel interpolation system performs texture mapping, a texture coordinate is shifted to the 2nd shift direction, and a texel interpolation system performs texture mapping.
[0013]If it does in this way, a still more ideal shading-off picture can be generated.
[0014]As for the 1st shift direction and 2nd shift direction, it is desirable that it is an opposite direction mutually. It is still more desirable to set a shift to the 1st shift direction and a shift to the 2nd shift direction two or more times.
[0015]An image generation system, an information storage medium, and a program concerning this invention are characterized by said object being a virtual object which has a shading-off field and identical shape.
[0016]When obscuring the whole screen, it is desirable to make an object and a shading-off field into a screen and identical shape, but it may be made to obscure only some fields of a screen.
[0017]This invention contains a means to combine an alpha value setting-out means to be an image generation system for generating a picture, and to set alpha value of each pixel as a value according to a depth value of each pixel of a source image, and a source image and a shading-off picture corresponding to this source image, based on alpha value set as each pixel. An information storage medium concerning this invention includes a program for being an usable information storage medium and performing the above-mentioned means by computer. A program concerning this invention contains a manipulation routine for being an usable program (a program embodied by subcarrier is included), and performing the above-mentioned means by computer.
[0018]According to this invention, based on alpha value set as a value according to a depth value of each pixel of a source image, it obscures with a source image and a picture is combined. Therefore, according to a depth value, it becomes possible to change compositing ratio of a shading-off picture, etc., and expression of depth of field etc. is attained.
[0019]alpha (alpha) value is information which is related with each pixel and memorized, for example, are information other than sexual desire news. A depth value may be made into such a large value that it is far from a viewpoint (virtual camera), and may be made into such a large value that it is near from a viewpoint. As the synthetic technique of a shading-off picture which is the synthetic target of a source image, various techniques are employable. A compositing process using alpha value is not limited to alpha blending.
[0020]An image generation system, an information storage medium, and a program concerning this invention carry out the feature of setting up alpha value of each pixel as a pixel in which a difference of a depth value of a focus of a virtual camera and a depth value of each pixel is [the aforementioned alpha value setting-out means] large so that compositing ratio of a shading-off picture may become high.
[0021]A picture which fade and is in sight by doing in this way, so that it is far from a focus can be generated now.
[0022]What is necessary is just to enlarge alpha value, so that a difference of a depth value with a focus is large, when it obscures, so that alpha value is large, and compositing ratio of a picture becomes high. What is necessary is just to make alpha value small, so that a difference of a depth value with a focus is large, when it obscures, so that alpha value is small, and compositing

ratio of a picture becomes high.
[0023]An image generation system, an information storage medium, and a program concerning this invention are changing correspondence relation between a depth value of each pixel, and alpha value, and control the range of depth of field, or strength of a shading-off effect to variable.
[0024]If it does in this way, only by changing correspondence relation between a depth value and alpha value, a picture from which the range of depth of field and strength of a shading-off effect differ can be generated now, and the diversity of an image expression can be improved.
[0025]Especially with the range of depth of field, although not limited, it is a range between the nearest point that, for example, a clear picture which is not fading is acquired, and a far point. For example, alpha value can define a range which becomes smaller than a given value, and a range which becomes larger than a given value as a range of depth of field. Control of strength of a shading-off effect is realizable by, for example, changing a size of alpha value also with the same depth value.
[0026]This invention is characterized by that an image generation system for generating a picture comprises:
About a pixel which has the depth value in field AR1 between Z1 and Z2, set the alpha value as alpha 1, and the alpha value is set as alpha 2 about a pixel which has the depth value in field AR2 between Z2 and Z3. ...., an alpha value setting-out means to set the alpha value as alphai about a pixel which has the depth value in Zi and the field ARi between Zi+1.
A means to draw a picture based on alpha value set up by the aforementioned alpha value setting-out means.
An information storage medium concerning this invention includes a program for being an usable information storage medium and performing the above-mentioned means by computer. A program concerning this invention contains a manipulation routine for being an usable program (a program embodied by subcarrier is included), and performing the above-mentioned means by computer.
[0027]According to this invention, it is field AR1 and AR2... alpha values of a pixel in ARi are alpha 1 and alpha 2 respectively.... It is set as alphai. And alpha 1, alpha 2 which were set up .... Drawing processing of a picture is performed using alphai. If it does in this way, alpha value according to a depth value can be set up by simple processing. Correspondence relation between a depth value and alpha value can also be controlled now by simple processing to variable.
[0028]Picture drawing processing based on alpha value set up by this invention is obscured with a source image, and is not limited to a compositing process of a picture.
[0029]An image generation system, an information storage medium, and a program concerning this invention, The aforementioned alpha value setting-out means because a depth value draws object alumnus1 set as Z1 to a depiction area of a source image. alpha value of a pixel which is in the direction side of the 1st on the basis of object alumnus1 is updated, and a depth value updates alpha value of a pixel which is in the direction side of the 1st on the basis of object alumnus2 by drawing object alumnus2 set as Z2 to a depiction area of a source image. ....By drawing the object OBi set as Zi to a depiction area of a source image, a depth value updates alpha value of a pixel which is in the direction side of the 1st on the basis of the object OBi.
[0030]If it does in this way, alpha value according to a depth value can be set up by processing in which it is only to draw an object and in which a burden is light and high-speed.
[0031]The direction side of the 1st may be a back side, seeing from an object, and may be a near side.
[0032]An image generation system, an information storage medium, and a program concerning this invention update only a bit which carries out the mask of except for a bit used as an update object, and serves as an update object, when the aforementioned alpha value setting-out means draws an object to a depiction area of a source image and updates alpha value.
[0033]If it does in this way, alpha value can be updated by bitwise. It is desirable to carry out the mask of the sexual desire news of each pixel, etc., for example in the case of renewal of alpha value.
[0034]An image generation system, an information storage medium, and a program concerning

this invention, The aforementioned alpha value setting-out means because a depth value draws object alumnus1' set as Z1' to a depiction area of a source image. Update the n-th bit of alpha value of a pixel which is in the direction side of the 1st on the basis of object alumnus1' on the 1st level, and. By drawing to a depiction area of a source image, object alumnus1 which a depth value is set as Z1 one and has it in the direction side of the 1st on the basis of said object alumnus1'. an object -- alumnus -- one -- a standard -- the -- one -- a direction -- a side -- it is -- a pixel -- alpha -- a value -- the -- n -- a bit -- the -- two -- a level -- updating -- a depth value -- Z -- two -- ' -- setting up -- having -- an object -- alumnus -- two -- ' -- a source image -- a depiction area -- drawing -- things. Update the n+1st bit of alpha value of a pixel which is in the direction side of the 1st on the basis of object alumnus2' on the 1st level, and. By drawing object alumnus2 which a depth value is set as Z2 two and has it in the direction side of the 1st on the basis of said object alumnus2' to a depiction area of a source image, the n+1st bit of alpha value of a pixel which is in the direction side of the 1st on the basis of object alumnus2 is updated on the 2nd level. .... and a depth value object OBi' set as Zi' by drawing to a depiction area of a source image. Update n-th+i-1 bit of alpha value of a pixel which is in the direction side of the 1st on the basis of object OBi' on the 1st level, and. the [of alpha value of a pixel which is in the direction side of the 1st on the basis of the object OBi by drawing the object OBi where a depth value is set as Zi, and which has it in the direction side of the 1st on the basis of said object OBi' to a depiction area of a source image] -- n+i-1 bit is updated on the 2nd level

[0035]Here, the direction side of the 1st may be a back side, seeing from an object, and may be a near side.

[0036]

[Embodiment of the Invention]Hereafter, the suitable embodiment of this invention is described using a drawing.

[0037]1. An example of the block diagram of this embodiment is shown in the lineblock diagram 1. this embodiment just containing the treating part 100 (or -- the treating part 100, the storage parts store 170 or the treating part 100, the storage parts store 170, and the information storage medium 180 are included -- ****ing), and at least, it in the figure, About the other block (for example, the final controlling element 160, the indicator 190, the sound output part 192, the portable information storage device 194, the communications department 196), it can be considered as arbitrary components.

[0038]The treating part 100 performs processing of various kinds, such as control of the whole system, directions of the command to each block in a system, game processing, image processing, and sound processing, here, and the function, It is realizable by hardwares, such as various processors (CPU, DSP, etc.) or ASIC (gate array etc.), and a given program (game program).

[0039]The final controlling element 160 is for a player to input manipulation data, and can realize the function by hardwares, such as a lever, a button, and a housing.

[0040]The storage parts store 170 serves as work regions, such as the treating part 100 and the communications department 196, and can realize the function by hardwares, such as RAM.

[0041]The information storage medium (it is an usable storage by a computer) 180, The information on a program, data, etc. is stored and hardwares, such as an optical disc (CD, DVD), a magneto-optical disc (MO), a magnetic disk, a hard disk, magnetic tape, or a memory (ROM), can realize the function. The treating part 100 performs processing of the versatility of this invention (this embodiment) based on the information stored in this information storage medium 180. That is, the information (a program or data) for performing the means (block included especially in the treating part 100) of this invention (this embodiment) is stored in the information storage medium 180.

[0042]A part or all of information that is stored in the information storage medium 180 will be transmitted to the power up to a system, etc. at the storage parts store 170. The information memorized by the information storage medium 180, At least one, such as information for directing processing of the program code for processing this invention, image data, sound data, the formed data of a display thing, table data, list data, and this invention and information for

processing according to the directions, is included.
[0043]The indicator 190 outputs the picture generated by this embodiment, and can realize the function by hardwares, such as CRT, LCD, or HMD (head mount display).
[0044]The sound output part 192 outputs the sound generated by this embodiment, and can realize the function by hardwares, such as a loudspeaker.
[0045]Personal data, save data, etc. of a player are memorized and the portable information storage device 194 can consider a memory card, a portable game device, etc. as this portable information storage device 194.
[0046]The communications department 196 performs various kinds of control for communicating between the exteriors (for example, a host device and other image generation systems), and can realize the function by hardwares, such as various processors or ASIC for communication, a program, etc.
[0047]It may be made to distribute the program or data for performing the means of this invention (this embodiment) to the information storage medium 180 via a network and the communications department 196 from the information storage medium which a host device (server) has. Use of the information storage medium of such a host device (server) is also included within the limits of this invention.
[0048]The treating part 100 contains the game processing part 110, the image generation part 130, and the sound generation part 150.
[0049]The game processing part 110 here The managing acceptance of coin (price), the setting processing in the various modes, the position of advance processing of a game, the setting processing of a selection picture, and an object (1 or two or more primitive surfaces), and angle of rotation (X.) The processing which asks for Y or circumference angle of rotation of the Z-axis, the processing which operates an object (motion processing), The processing which asks for the position (position of a virtual camera) and look angle (angle of rotation of a virtual camera) of a viewpoint, The processing for arranging objects, such as a map object, to object space, Hit check processing, the processing which calculates a game result (a result, results), processing for two or more players to play in common game space, Or various game processings, such as game exaggerated processing, are performed based on the manipulation data from the final controlling element 160, the personal data from the portable information storage device 194, preserved data, a game program, etc.
[0050]The image generation part 130 generates the picture which performs various kinds of image processing according to the directions from the game processing part 110, etc., for example, is in sight from a virtual camera (viewpoint) in object space, and outputs it to the indicator 190. The sound generation part 150 performs various kinds of sound processings according to the directions from the game processing part 110, etc., generates sounds, such as BGM, a sound effect, and a sound, and outputs them to the sound output part 192.
[0051]The function of the game processing part 110, the image generation part 130, and the sound generation part 150 may realize the all by hardware, and may realize the all by a program. Or both hardware and a program may realize.
[0052]The image generation part 130 contains the geometry treating part 132 (three-dimensional operation part), alpha (alpha) value set part 134, the shading-off (Blois) image generation part 136, and the drawing part 140 (rendering part).
[0053]Here, the geometry treating part 132 performs various geometry processing (three-dimensional operation), such as coordinate conversion, clipping processing, transparent transformation, or light source calculation. And the object data (formed data, such as apex coordinates of an object, or a peak texture coordinate, luminance data, etc.) after geometry processing (after transparent transformation) is saved at the main memory 172 of the storage parts store 170.
[0054]alpha value set part 134 performs processing which sets alpha value (it is the information memorized by relating with each pixel, for example, they are information other than sexual desire news) of each pixel as the value according to Z value (a broad sense depth value) of each pixel of a source image (for example, picture after transparent transformation). And the range of depth of field and the strength of a shading-off effect are controlled by alpha value set part 134

changing the correspondence relation between the depth value of each pixel, and alpha value by variable. alpha value of each pixel is set up as a pixel with alpha value set part 134 far from the focus of a virtual camera so that alpha value may become large (the compositing ratio of a shading-off picture becomes high at a broad sense like).
[0055]The shading-off image generation part 136 performs processing for generating the shading-off picture (picture which faded most) which is used as a source image as for alpha composition (alpha blending, alpha addition, alpha subtraction, translucence processing, etc.).
[0056]By this embodiment, the bilinear filter method (texel interpolation system which contains a try linear filter method etc. in a broad sense) of texture mapping is used effectively and obscured, and, more specifically, a picture is generated. Namely, the shading-off image generation part 136 sets up a source image as a texture, When this texture is mapped in an object (virtual object of a shading-off field and identical shape) by a bilinear filter method, processing (processing to shift and to which it is made to process and move) to which only a value smaller than for example, 1 texel shifts the texture coordinate of an object is performed. If it does in this way, the shading-off picture which is the synthetic target of a source image can be generated by simple processing in which it is only to shift a texture coordinate.
[0057]The drawing part 140 performs processing which draws the picture which is in sight from a virtual camera in object space based on object data, a texture, etc.
[0058]The drawing part 140 contains the texture-mapping part 142, the alpha synchronizer 144, and the hidden-surface-removal part 146.
[0059]The texture-mapping part 142 performs here processing which maps the texture memorized by the texture storage parts store 176 in an object (primitive surface of a polygon, a free sculptured surface, etc.) with a bilinear filter method (texel interpolation system) or point sampling systems.
[0060]The alpha synchronizer 142 performs processing which combines a source image and the shading-off picture generated by the shading-off image generation part 136 based on alpha value (A value) set up by alpha value set part 134 to each pixel. For example, when alpha composition is alpha blending, it obscures with a source image like a lower type, and a picture is combined.
[0061]
R_Q=(1−alpha) xR_1+ alphaxR_2 (1)
G_Q=(1−alpha) xG_1+ alphaxG_2 (2)
B_Q=(1−alpha) xB_1+ alphaxB_2 (3)
Here R_1, G_1, and B_1, It is R of the color (luminosity) of the source image already drawn by the frame buffer 174, G, and B ingredient, and R_2, G_2, and B_2 are R of the color of the shading-off picture generated by the shading-off image generation part 136, G, and B ingredient. R_Q, G_Q, and B_Q are outputted images generated by alpha blending.
[0062]The hidden-surface-removal part 144 performs hidden surface removal according to the algorithm of the Z buffer algorithm using Z-uffer 178 (Z plain) in which Z value (depth value) is stored. In this embodiment, renewal of alpha value by drawing of a virtual object is realized using the function of this hidden-surface-removal part 144.
[0063]The image generation system of this embodiment may be used as the system only for single handicap player mode which can play only one person's player, and may be used as a system provided not only with such single handicap player mode but the multiplayer mode which can play two or more players.
[0064]When two or more players play, the game image and game sound with which two or more of these players are provided may be generated using one terminal, and may be generated using two or more terminals connected in the network (a transmission line, a communication line) etc.
[0065]2. As the feature 2.1 alpha (alpha) composition book embodiment of this embodiment shows to E1 of drawing 2, alpha plain (plain to which alpha value of each pixel is set) as set alpha value alphaA of each pixel, alphaB, alphaC, and alphaD as the value according to each pixel A, B, and C of a source image, the Z value ZA of D, ZB, ZC, and ZD, for example, shown in E2 is

generated. More specifically, alpha value (alpha value near 1.0) with a further pixel (pixel with a large difference of Z value with a focus) bigger, for example from the focus (point of regard) of the virtual camera 10 is set up. Thereby, in the further pixel from the focus of the virtual camera 10, the compositing ratio of a shading-off picture becomes high.

[0066]Z value may be made into the value which becomes so large that it is far from the virtual camera 10, and may be made into the value which becomes so large that it is near from the virtual camera 10. May make it the compositing ratio of a shading-off picture become high, and, so that alpha value approaches 1.0 (100%). It may be made for the compositing ratio of a shading-off picture to become high, so that alpha value approaches 0.0 (0%) (in this case, what is necessary is just to replace alpha-1 and alpha by (1) of an upper type, (2), and (3)).

[0067]And according to this embodiment, as shown in E3 of drawing 2, based on generated alpha plain (alpha value set as each pixel at a broad sense), it obscures with a source image and alpha composition (alpha blending etc.) of a picture is performed. The example of the source image of which alpha composition is done, and a shading-off picture is shown in drawing 3 (A) and (B).

[0068]By thus, the thing for which it obscures with a source image based on alpha value set up according to Z value (depth value), and alpha composition of a picture is performed. For example, the picture which fade and is in sight can be generated, so that it becomes far from the focus (point set up as a focused point) of a virtual camera, and the so-called expression of depth of field is attained. The real and natural game image by which focusing was carried out by this to all the photographic subjects in a screen according to the distance from a viewpoint like the view image of the real world unlike the focused conventional game image is generable. as a result, the virtual reality of a player is boiled markedly and it can improve.

[0069]And according to this embodiment, since the operation based on the physical relationship of each object and a viewpoint becomes unnecessary (such an operation may be performed), there is an advantage that expression of depth of field is attained by few processing burdens.

[0070]2.2 An example of setting out of alpha value according to Z value is shown in alpha value setting-out drawing 4 (A), drawing 4 (B), and drawing 5 (A) and (B).

[0071]For example, in drawing 4 (A), division of the fields AR0-AR4, AR1' - AR4' is performed by the Z values Z1-Z4, Z1' - Z4' (threshold). And the alpha values alpha0-alpha4, alpha1' - alpha4' are set up to these fields AR0-AR4, AR1' - AR4'.

[0072]For example, about the pixel in field AR1 between Z1-Z2, the alpha value is set as alpha 1, and the alpha value is set as alpha 2 about the pixel in field AR2 between Z2-Z3. About the pixel in field AR1' between Z1' - Z2', the alpha value is set as alpha1', and the alpha value is set as alpha2' about the pixel in field AR2' between Z2' - Z3'.

[0073]And the following expressions of relations are realized in alpha value set as each field.

[0074]

alpha0<alpha1 <alpha2 <alpha3 <alpha4 (4)

alpha0<alpha1'<alpha2'<alpha3'<alpha4' (5)

alpha value is large, so that from these formulas (4) and (5) and it is far from the focus (point of regard) of the virtual camera 10 (by the upper formula (1), (2), and (3), when alpha-1 and alpha are replaced, alpha value is conversely made small, so that it is far from a focus). That is, in this embodiment, alpha value is set up as a pixel with a large difference of Z value with the focus of the virtual camera 10 so that the compositing ratio of a shading-off picture may become high.

[0075]At this embodiment, the range of depth of field and the strength of a shading-off effect are controlled by changing the correspondence relation between Z value of each pixel, and alpha value to variable.

[0076]For example, alpha value presupposes that the range (range as for which the compositing ratio of a shading-off picture becomes smaller than 100%) which becomes smaller than 1.0 was defined as a range of depth of field. Then, if Z value and alpha value are made to correspond like drawing 4 (A), the range of depth of field can be made large. On the other hand, if Z value and alpha value are made to correspond like drawing 4 (B), the range of depth of field can be narrowed.

[0077]alpha value which pinpoints the boundary of the range of depth of field is not limited to 1.0, but is arbitrary.

[0078]If Z value and alpha value are made to correspond like drawing 5 (A), a shading-off effect can be weakened, and if Z value and alpha value are made to correspond like drawing 5 (B), a shading-off effect can be strengthened. Namely, in drawing 5 (A), it receives that alpha value of field AR2 (or AR2') of Z2-Z3 (or Z2'-Z3') is set as 0.4 (weak shading-off effect), for example, In drawing 5 (B), it is because alpha value of AR2 (or AR2') is set as 0.7 (strong shading-off effect).

[0079]As shown in drawing 6 (A), at this embodiment, alpha value to each field is set to division of a field by both the back side and the near side on the basis of the focus. However, as shown in drawing 6 (B), alpha value to division of a field and each field may be set to the back side on the basis of a focus. Or as shown in drawing 6 (C), only in a near side, alpha value to each field may be set to division of a field on the basis of a focus.

[0080]Now, setting out of alpha value as shown in drawing 6 (A), (B), and (C) is specifically realizable with the following techniques.

[0081]That is, as shown in drawing 7 (A), Z value is a frame buffer (in a broad sense.) first about object alumnus1 (polygon) set as Z1. By drawing to the depiction area of a source image, alpha value of the pixel which is in the back side (direction side of the 1st which also contains a near side in a broad sense) on the basis of object alumnus1 is updated. That is, the hidden-surface-removal technique (Z buffer algorithm) based on Z value is used effectively, and alpha value of the pixel which is in the back side rather than alumnus1 is updated.

[0082]Next, as shown in drawing 7 (B), Z value updates alpha value of the pixel which is in the back side on the basis of object alumnus2 by drawing object alumnus2 set as Z2 to a frame buffer. Similarly, as shown in drawing 7 (C), Z value updates alpha value of the pixel which is in the back side on the basis of object alumnus3 by drawing object alumnus3 set as Z3 to a frame buffer.

[0083]If such a technique is adopted, alpha value of the pixel in field AR1 is set as alpha 1, alpha value of the pixel in field AR2 is set as alpha 2, and alpha value of the pixel in field AR3 can be set as alpha 3.

[0084]And in this technique, alpha value is automatically updated by the hidden-surface-removal function using Z-uffer only by drawing an object to the frame buffer where the source image is drawn. Therefore, there is an advantage that desired alpha value can be set as the pixel in each field by very few processing burdens.

[0085]Now, the further detailed example of the setting-out technique of alpha value (alpha plain) is shown in drawing 8 (A) - drawing 9 (D).

[0086]First, as shown in drawing 8 (A), alpha value of all the fields AR0-AR3, AR1' - AR3' is initialized, for example (111) (when alpha value is a triplet).

[0087]next -- drawing 8 -- (-- B --) -- being shown -- as -- Z -- a value -- Z -- one -- ' -- setting up -- having -- alpha -- for example, -- (-- 000 --) -- setting up -- having -- an object -- alumnus -- one -- ' -- a frame buffer -- drawing -- things. The 1st bit of alpha value of the pixel which is in the back side (a broad sense the direction side of the 1st) rather than object alumnus1' (near) is updated to 0 (a broad sense the 1st level). However, in this case, the mask is carried out about bits other than the 1st (update object bit) bit, and the 1st bit is updated.

[0088]Next, as shown in drawing 8 (C), Z value is set as Z1 and alpha updates the 1st bit of alpha value of the pixel which is in the back side rather than object alumnus1 (far) to 1 (a broad sense the 2nd level) by drawing object alumnus1 set as (111) to a frame buffer. However, about bits other than the 1st bit, the mask is carried out also in this case.

[0089]By making it above, alpha value of field AR0 is set as (110), and alpha value of other fields is set as (111). That is, alpha value set as alpha value set as field AR0 and other fields can be changed.

[0090]Next, as shown in drawing 9 (A), the 2nd bit of alpha value of the pixel which is in the back side rather than object alumnus2' is updated to 0 by drawing object alumnus2' of alpha= (000) by Z=Z2' (it is a mask except the 2nd bit).

[0091]Next, as shown in drawing 9 (B), the 2nd bit of alpha value of the pixel which is in the back side rather than object alumnus2 is updated to 1 by drawing object alumnus2 of alpha= (111) by

Z=Z2 (it is a mask except the 2nd bit).

[0092]By making it above, alpha value of field AR0 is set as (100), field AR1' and alpha value of AR1 are set as (101), and alpha value of other fields is set as (111).

[0093]Next, as shown in drawing 9 (C), the triplet eye of alpha value of the pixel which is in the back side rather than object alumnus3' is updated to 0 by drawing object alumnus3' of alpha=(000) by Z=Z3' (it is a mask except a triplet eye).

[0094]Next, as shown in drawing 9 (D), the triplet eye of alpha value of the pixel which is in the back side rather than object alumnus3 is updated to 1 by drawing object alumnus3 of alpha=(111) by Z=Z3 (bits other than a triplet eye are masks).

[0095]By making it above, alpha value of field AR0 is set as (000), field AR1' and alpha value of AR1 are set as (001), field AR2' and alpha value of AR2 are set as (011), and field AR3' and alpha value of AR3 are set as (111).

[0096]That is, a pixel (field) with a larger difference of Z value with the focus of the virtual camera 10 is set as a value with big alpha value, and the compositing ratio of a shading-off picture becomes high. Therefore, setting out of the optimal alpha value for expression of depth of field can be realized by simple and high-speed processing in which it is only to draw an object, carrying out the mask of the specific bit.

[0097]Above, the case where alpha value of the pixel in the back side of the object was updated by drawing an object was explained. However, when the image generation system has a function which can update alpha value of the pixel which is in the near side of an object by drawing of an object, a function which can reverse Z value, etc. It may be made to update alpha value of the pixel in the near side of the object by drawing an object.

[0098]2.3 In generation, now this embodiment of a shading-off picture, the bilinear filter method (texel interpolation system) of texture mapping is used effectively, and the shading-off picture (drawing 3 (B)) which is the synthetic target of a source image (drawing 3 (A)) is generated.

[0099]That is, the position of a pixel and the position of texel may shift in texture mapping.

[0100]In this case, as shown in drawing 10, in point sampling systems, color CP (a broad sense picture information) of the pixel (sampling point) P turns into P to color CA of texel TA with the nearest distance.

[0101]On the other hand, in a bilinear filter method, color CP of P becomes the color which interpolated the surrounding texel TA, TB, and TC, the colors CA, CB, and CC of TD, and CD of P.

[0102]More specifically based on the coordinates of TA-TD, and the coordinates of P, it asks for coordinates ratio beta:1-beta (0<=beta<=1) of an X axial direction, and coordinates ratio gamma:1-gamma (0<=gamma<=1) of Y shaft orientations.

[0103]In this case, color CP (output color in a bilinear filter method) of P becomes like a lower type.

[0104]

CP=(1-beta) x(1-gamma) x CA+beta x(1-gamma) xCB+(1-beta) x gammaxCC+betaxgammaxCD (6)

At this embodiment, the shading-off picture is generated by the bilinear filter method in this way paying attention to a color being interpolated automatically.

[0105]As more specifically shown in F1 of drawing 11, the source image drawn by the frame buffer is set up as a texture. and the texture coordinate given to the peak of an object when this texture (source image) is mapped by a bilinear filter method in an object -- for example (0.5, 0.5) -- only -- it is made to shift in the direction of the lower right (movement to shift) By doing in this way, a shading-off picture to which the color of the pixel of a source image bled around automatically with the interpolation function of the bilinear filter method can be generated now.

[0106]When obscuring the whole screen, the shape of the object (virtual object which is not displayed) which maps a texture (source image) is set as a screen (shading-off field) and identical shape. Namely, when the apex coordinates of a screen are = (X, Y) (0, 0), (640, 0), (640, 480), and (0, 480), the apex coordinates of an object are also set to = (X, Y) (0, 0), (640, 0), (640, 480), and (0, 480).

[0107]And in this case, if the texture coordinate (U, V) given to peak VX1 of an object, VX2,

VX3, and VX4 is set as (0, 0), (640, 0), (640, 480), and (0, 480), respectively. It is in agreement, without the position of the pixel of a screen and the position of the texel of a texture shifting. Therefore, a picture does not fade.
[0108]on the other hand, the texture coordinate (U.) given to peak VX1 of an object, VX2, VX3, and VX4 V) Respectively, if it is set as (0.5, 0.5), (640.5, 0.5), (640.5, 480.5), and (0.5, 480.5), the position of the pixel of a screen and the position of the texel of a texture will come to shift. Therefore, interpolation of a color is performed by the interpolation function of a bilinear filter method, a picture fades, and it comes to be visible.
[0109]What is necessary is just to make shape of an object into the shading-off field and identical shape, in obscuring some fields of a screen.
[0110]According to this embodiment, as shown in G1 of drawing 12, a source image is set as a texture, for example, only 0.5 texel is shifted in the direction of the lower right (the 1st shift direction), a bilinear filter method performs texture mapping, and the 1st shading-off picture is generated. Next, as shown in G2 of drawing 12, this 1st shading-off picture is set as a texture, for example, only 0.5 texel is shifted in the direction of the upper left (the 2nd shift direction), a bilinear filter method performs texture mapping, and the 2nd shading-off picture is generated. Or the above processing (the shift of the direction of the lower right and the shift of the direction of the upper left) is repeated two or more times. By doing in this way, it can be still more natural, and can obscure, and the strong shading-off picture of an effect can be generated now.
[0111]Next, the principle which is obscured with the interpolation function of a bilinear filter method and by which a picture is generated is explained.
[0112]For example, as shown in drawing 13 (A), only 0.5 texel shifts a texture coordinate in the direction of the lower right, and suppose that texture mapping of the bilinear filter method was performed. In this case, since it is set to beta=gamma =1/2 in an upper type (6), if the color of the texel T44, T45, T54, and T55 is set to C44, C45, C54, and C55, color CP44 of the pixel P44 will become like a lower type.
[0113]
$CP44=(C44+C45+C54+C55)/4$ (7)
As mentioned above, the color C44 (equivalent to the original color of the pixel P44 of the source image before conversion) of the texel T44 will ooze out every [4 / 1/] to the surrounding pixel P33, P34, P43, and P44 by conversion shown in drawing 13 (A) so that clearly.
[0114]And as shown in drawing 13 (B) after that, suppose that only 0.5 texel shifted the texture coordinate in the direction of the upper left, and the bilinear filter method performed texture mapping by making into a texture the picture acquired by drawing 13 (A). In this case, the pixel P33 of drawing 13 (A), P34, P43, and P44 come to correspond to the texel T33 of drawing 13 (B), T34, T43, and T44. and the color C44 which oozed out every [4 / 1/] to P33, P34, P43, and P44 (T33, T34, T43, T44) by drawing 13 (A) -- it will 1/quadruple and will ooze out to four surrounding pixels. namely, -- after all -- the original color C44 of T44 -- 4x1 [1/]/4 = -- it will ooze out around every [16 / 1/].
[0115]therefore, conversion of drawing 13 (A) and (B) -- the pixel P33, P34, and P35 -- each and the color C44 (equivalent to the original color of the pixel P44 of the source image drawn on the frame buffer) -- 1/16 and 2/16 -- it will ooze out every [16 / 1/]. moreover -- the pixel P43, P44, and P45 -- each and the color C44 -- 2/16 and 4/16 -- oozing out every [16 / 2/] -- the pixel P53, P54, and P55 -- each and the color C44 -- 1/16 and 2/16 -- it will ooze out every [16 / 1/].
[0116]Therefore, a flat-surface filter as shown in drawing 14 (A) comes to be given to a source image after all by conversion of drawing 13 (A) and (B). According to this flat-surface filter, the color of each pixel of a source image comes to spread uniformly around it, and can generate the ideal shading-off picture of a source image.
[0117]If conversion of drawing 13 (A) and (B) is set twice, a flat-surface filter as shown in drawing 14 (B) will come to be given to a source image. According to this flat-surface filter, a shading-off picture still more ideal than drawing 14 (A) is generable.
[0118]3. Explain the detailed example of processing of this embodiment, next processing of this embodiment using the flow chart of drawing 15 and drawing 16.

[0119]First, a source image (picture after transparent transformation) is drawn to a frame buffer (Step S1). Next, alpha plain (alpha channel) is created with the technique explained by drawing 8 (A) - drawing 9 (D) (Step S2). And j is initialized to 0 (Step S3).

[0120]Next, as shown in G1 of drawing 12, the source image of a frame buffer is set as a texture, and the texture is mapped in another buffer (step S4). And at this time, only (0.5 and 0.5) shift a texture coordinate, and it maps by a bilinear filter method.

[0121]Next, as shown in G2 of drawing 12, the picture of another buffer is set as a texture and the texture is mapped in a frame buffer (Step S5). And at this time, only (-0.5 and -0.5) shift a texture coordinate, and it maps by a bilinear filter method. As shown in E3 of drawing 2, using alpha plain generated at Step S2, it obscures with a source image (drawing 3 (A)), and alpha blending of a picture (drawing 3 (B)) is performed.

[0122]Next, only 1 **************s j (Step S6). And it judges whether j exceeded M (repeat frequency of shading-off conversion) (Step S7), when not having exceeded, it returns to step S4, and processing is ended when it exceeds.

[0123]Drawing 16 is a detailed flow chart of alpha plain generation processing of drawing 15.

[0124]First, as drawing 8 (A) explained, all the alpha values of alpha plain are initialized by $2^{m}-2^{n-1}$ (Step S10). And i is initialized to n (Step S11).

[0125]Here, m and n are the maximum bit of alpha plain created respectively, and a minimum bit. For example, alpha value is 8 bits and, in the case of m= 6 and n= 4, alpha value of alpha plain is initialized by (00111000) by Step S10. That is, alpha value will be initialized by the value from which from m bit to all n bits are set to 1, and the other bit is set to 0 by initialization of Step S10.

[0126]Next, the mask of except [of alpha value / i bit] is carried out among R of the source image of a frame buffer, G, B, and alpha value (Step S12). And as drawing 8 (B) explained, Z=Zi' (near) and alpha value of the pixel which draws the object (polygon) of alpha= (00000000) to a frame buffer, and is in the back side rather than the object are updated (Step S13). Next, as drawing 8 (C) explained, the object of Z=Zi (far) and alpha= (11111111) is drawn to a frame buffer, and alpha value of the pixel which is in the back side rather than the object is updated (Step S14).

[0127]Next, only 1 **************s i (Step S15). And it judges whether i exceeded K (Step S16), when not having exceeded, it returns to Step S12, and when it exceeds, creation processing of alpha plain is ended.

[0128]4. An example of hardware constitutions, next the composition of the hardware which can realize this embodiment is explained using drawing 17.

[0129]A program by which the general purpose processor 900 was stored in CD982 (information storage medium), It operates based on the program transmitted via the communication interface 990, or the program stored in ROM950 (one of the information storage media), and processing of versatility, such as game processing, image processing, and sound processing, is performed.

[0130]The co-processor 902 assists processing of the general purpose processor 900, has the integrating adder and divider in which high-speed parallel operation is possible, and performs matrix arithmetic (vector operation) at high speed. For example, when processing of matrix arithmetic etc. is required, the program which operates on the general purpose processor 900 directs the processing to the co-processor 902 at the physics simulation for moving an object or making it operate (motion) (request).

[0131]The geometry processor 904 performs geometry processing, such as coordinate conversion, transparent transformation, light source calculation, and curved-surface generation, has the integrating adder and divider in which high-speed parallel operation is possible, and performs matrix arithmetic (vector operation) at high speed. For example, in processing coordinate conversion, transparent transformation, light source calculation, etc., the program which operates by the general purpose processor 900 directs the processing to the geometry processor 904.

[0132]The data extension processor 906 performs decoding which elongates the compressed image data and sound data, or performs processing which carries out the AKUSE rate of the decoding of the general purpose processor 900. Thereby, the video compressed with the MPEG system etc. can be displayed now in an opening screen, an intermission screen, an ending screen, or a game screen. The image data and sound data which are the targets of decoding are stored in ROM950 and CD982, or are transmitted from the outside via the communication interface 990.

[0133]The drawing processor 910 performs drawing (rendering) processing of the object which comprises a primitive surface of a polygon, a curved surface, etc. at high speed. If the general purpose processor 900 passes object data to the drawing processor 910 using the function of DMA controller 970 and it is required in the case of drawing of an object, a texture will be transmitted to the texture storage parts store 924. Then, the drawing processor 910 draws an object at high speed to the frame buffer 922, performing hidden surface removal using Z-uffer etc. based on these object data and textures. The drawing processor 910 can perform alpha blending (translucence processing), depth queing, Mip Mapping, fog processing, bi-linear filtering, try linear filtering, anti-aliasing, a shading process, etc. And if the picture for one frame is written in the frame buffer 922, the picture will be displayed on the display 912.

[0134]The sound processor 930 builds in the ADPCM sound source of a multi-channel, etc., and generates high-definition game sounds, such as BGM, a sound effect, and a sound. The generated game sound is outputted from the loudspeaker 932.

[0135]Data transfer of the manipulation data from the game controller 942, the save data from the memory card 944, and the personal data is carried out via the serial interface 940.

[0136]A system program etc. are stored in ROM950. In the case of a business-use game system, ROM950 will function as an information storage medium, and various programs will be stored in ROM950. It may be made to use a hard disk instead of ROM950.

[0137]RAM960 is used as workspace of various processors.

[0138]DMA controller 970 controls the DMA transfer between a processor and memories (RAM, VRAM, ROM, etc.).

[0139]CD drive 980 drives CD982 (information storage medium) in which a program, image data, or sound data is stored, and enables these programs and access to data.

[0140]The communication interface 990 is an interface for performing data transfer between the exteriors via a network. In this case, as a network connected to the communication interface 990, a communication line (an analog telephone line, ISDN), a fast serial bus, etc. can be considered. And the data transfer which passed the Internet by using a communication line becomes possible. The data transfer between other image generation systems and other game systems becomes possible by using a fast serial bus.

[0141]Each means of this invention may perform the all only by hardware, and may perform them only by the program stored in an information storage medium, or the program distributed via a communication interface. Or it may perform by both hardware and a program.

[0142]And when performing each means of this invention by both hardware and a program, the program for using each means of this invention, using hardware for an information storage medium, and performing will be stored. Data will be passed, if the above-mentioned program directs processing in each processors 902, 904, 906, and 910 and 930 grades which are hardware and it is more specifically required. And each processors 902, 904, 906, and 910 and 930 grades will perform each means of this invention based on the directions and the passed data.

[0143]The example at the time of applying this embodiment to a business-use game system is shown in drawing 18 (A). Looking at the game image projected on the display 1100, a player operates the lever 1102 and button 1104 grade, and enjoys a game. Various processors, various memories, etc. are mounted in the system board (circuit board) 1106 built in. And the information (a program or data) for performing each means of this invention is stored in the memory 1108 which is an information storage medium on the system board 1106. Hereafter, this information is called stored information.

[0144]The example at the time of applying this embodiment to a game system for home use is shown in drawing 18 (B). Looking at the game image projected on the display 1200, a player operates the game controllers 1202 and 1204 and enjoys a game. In this case, the above-mentioned stored information is stored in CD1206 which is an information storage medium which

can be freely detached and attached to a body system or the memory card 1208, and 1209 grades.
[0145]drawing 18 (C) -- the host device 1300, this host device 1300, and the network 1302 (a small-scale network like LAN.) The example at the time of applying this embodiment is shown in the system containing the terminal 1304-1 connected via a wide area network like the Internet - 1304-n. In this case, the above-mentioned stored information is stored in the information storage media 1306, such as a magnetic disk drive with the controllable host device 1300, a magnetic tape handler, and a memory, for example. When the terminal 1304-1 - 1304-n are what can generate a game image and a game sound by a stand-alone, from the host device 1300, the game program for generating a game image and a game sound, etc. are delivered by the terminal 1304-1 - 1304-n. On the other hand, when ungenerable by a stand-alone, a game image and a game sound are generated, and the host device 1300 will transmit this to the terminal 1304-1 - 1304-n, and will output in a terminal.
[0146]In the composition of drawing 18 (C), a host device (server) and a terminal distribute, and it may be made to perform each means of this invention to it. It distributes to the information storage medium of a host device (server), and the information storage medium of a terminal, and may be made to store the above-mentioned stored information for performing each means of this invention.
[0147]The terminal linked to a network may be a home game system, and may be a business-use game system. And in connecting a business-use game system to a network. The exchange of information is possible between business-use game systems, and it is desirable to use the portable information storage device (a memory card, a portable game device) also between home game systems which can exchange information.
[0148]What [not only] was explained by the above-mentioned embodiment but various modification implementation is possible for this invention.
[0149]For example, in the invention which relates to a dependent claim among this inventions, it can also have composition which omits some constituent features of the claim of the subordinate point. The important section of the invention concerning the independent claim of 1 of this invention can also be subordinated to other independent claims.
[0150]Although the setting-out technique of alpha value has especially the desirable technique explained by drawing 6 (A) - drawing 9 (D), it is not limited to this. For example, it may be made to make it change continuously, without changing alpha value gradually to change of a depth value (Z value).
[0151]Although the shading-off picture which is the synthetic target of a source image has especially a desirable thing to generate with the technique explained by drawing 11 and drawing 12, it is not limited to this. For example, the picture which shifted the source image and the source image may be combined, or the source image of the frame concerned and the source image of a front frame may be compounded, it may obscure, and a picture may be generated.
[0152]In the invention which sets up alpha value like drawing 6 (A) - drawing 9 (D), set-up alpha value is obscured with a source image, and can be used for various picture drawing processings besides the compositing process of a picture. For example, processing which makes an object far from a viewpoint translucent and is made to melt into the maximum distant view may be performed using set-up alpha value.
[0153]The invention which obscures using a texel interpolation system and generates a picture is not limited to the technique explained by drawing 11 - drawing 14 (B), either. For example, the whole screen is not obscured, but a shading-off field smaller than a screen is set up, and it may be made to obscure the source image in the field.
[0154]In this embodiment, taking the case of the case where a depth value becomes large, it explained so that it kept away from the viewpoint, but it is not restricted to this. For example, this invention can be applied, also when a depth value becomes small so that it keeps away from a viewpoint.
[0155]This invention is applicable to various games (a fighting game, a shooting game, a robot versus fighting game, sports games, a competitive game, a role playing game, a music performance game, a dance game, etc.).

[0156]This invention is applicable to various image generation systems, such as a system board which generates a business-use game system, a home game system, the large-sized attraction system with which many players participate, a simulator, a computer terminal for multimedia services, and a game image.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is an example of the block diagram of the image generation system of this embodiment.
[Drawing 2]It is a figure for explaining the technique of setting up alpha value according to Z value (depth value), obscuring it with a source image using set-up alpha value, and combining a picture.
[Drawing 3]Drawing 3 (A) and (B) is an example of a source image and its shading-off picture. It is a figure of a sake.
[Drawing 4]Drawing 4 (A) and (B) is a figure showing the technique of changing the correspondence relation between Z value and alpha value, and controlling the range of depth of field.
[Drawing 5]Drawing 5 (A) and (B) is a figure showing the technique of changing the correspondence relation between Z value and alpha value, and controlling the strength of a shading-off effect.
[Drawing 6]Drawing 6 (A), (B), and (C) is a figure for explaining the technique of classifying a field based on Z value and setting alpha value as each classified field.
[Drawing 7]Drawing 7 (A), (B), and (C) is a figure for explaining the technique of updating alpha value of the pixel by the side of the back of an object by drawing an object.
[Drawing 8]Drawing 8 (A), (B), and (C) is a figure for explaining the detailed example of the technique of updating alpha value.
[Drawing 9]Drawing 9 (A), (B), (C), and (D) are the figures for explaining the detailed example of the technique of updating alpha value.
[Drawing 10]It is a figure for explaining texture mapping of a bilinear filter method.
[Drawing 11]It is a figure for explaining the technique of using effectively and obscuring a bilinear filter method and generating a picture.
[Drawing 12]It is a figure for explaining the technique of using effectively and obscuring a bilinear filter method and generating a picture.
[Drawing 13]Drawing 13 (A) and (B) is a figure for explaining the principle which is obscured with the interpolation function of a bilinear filter method and by which a picture is generated.
[Drawing 14]Drawing 14 (A) and (B) is a figure for explaining the principle which is obscured with the interpolation function of a bilinear filter method and by which a picture is generated.
[Drawing 15]It is a flow chart which shows the detailed example of processing of this embodiment.
[Drawing 16]It is a flow chart which shows the detailed example of the generation processing of alpha plain.
[Drawing 17]It is a figure showing an example of the composition of the hardware which can realize this embodiment.
[Drawing 18]Drawing 18 (A), (B), and (C) is a figure showing the example of the system of various gestalten by which this embodiment is applied.
[Description of Notations]
10 Virtual camera

110 Game processing part
130 Image generation part
132 Geometry treating part
134 alpha value set part
136 Shading-off image generation part
140 Drawing part
142 Texture-mapping part
144 alpha synchronizer
146 Hidden-surface-removal part
150 Sound generation part
160 Final controlling element
170 Storage parts store
172 Main memory
174 Frame buffer
176 Texture storage parts store
178 Z-uffer
180 Information storage medium
190 Indicator
192 Sound output part
194 Portable information storage device
196 Communications department

[Translation done.]

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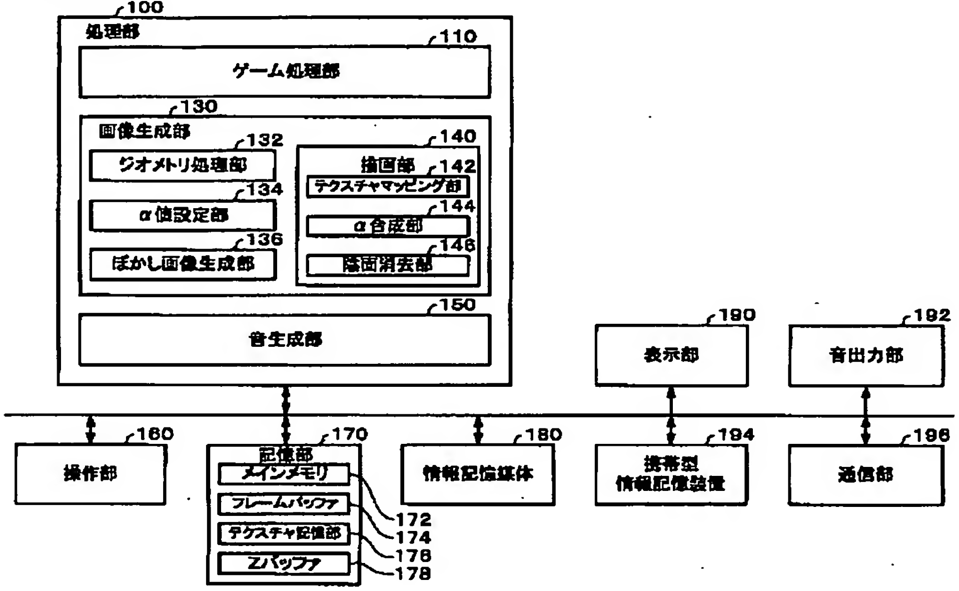
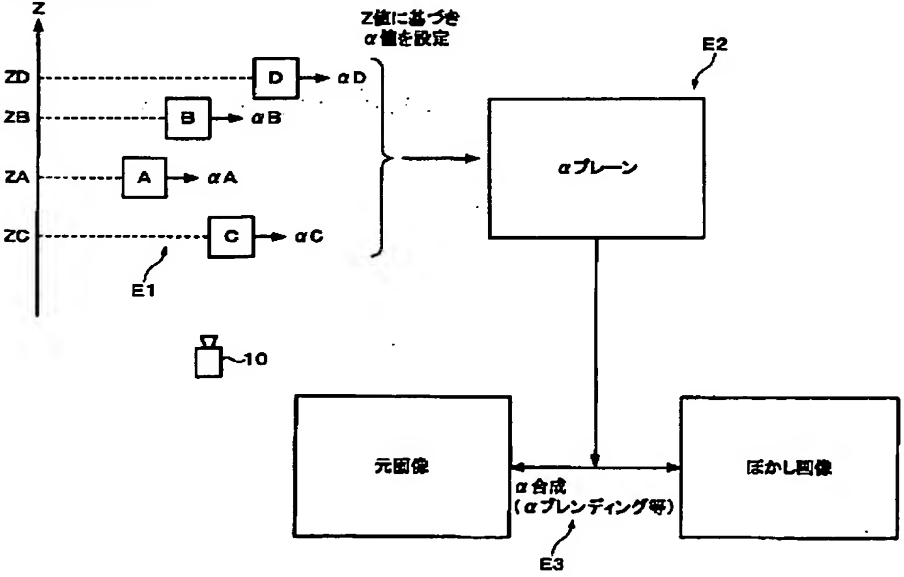
DRAWINGS

[Drawing 1]

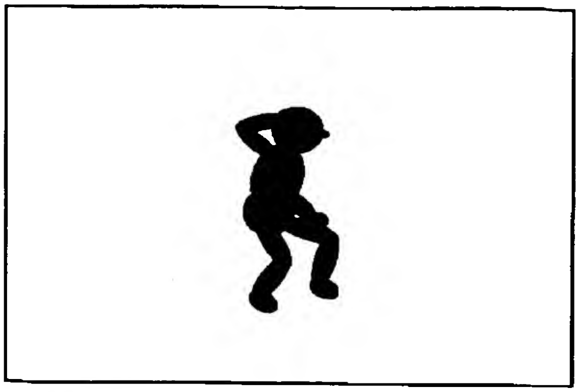

100
処理部
110
ゲーム処理部
130
画像生成部
132
ジオメトリ処理部
134
α値設定部
136
ぼかし画像生成部
140
描画部
142
テクスチャマッピング部
144
α合成部
146
陰面消去部
150
音生成部
190
表示部
192
音出力部
160
操作部
170
記憶部
メインメモリ
フレームバッファ
テクスチャ記憶部
Zバッファ
172
174
176
178
180
情報記憶媒体
194
携帯型
情報記憶装置
196
通信部

[Drawing 2]

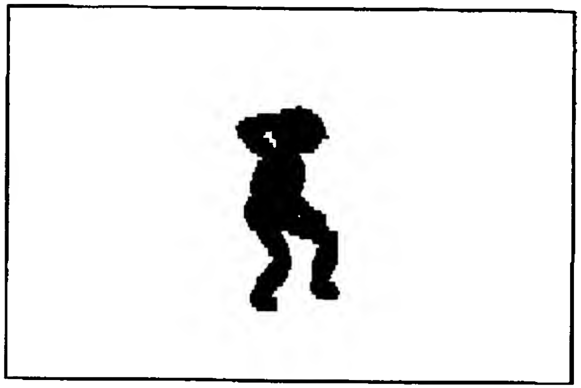

Z
ZD
ZB
ZA
ZC
D
B
A
C
αD
αB
αA
αC
E1
Z値に基づき
α値を設定
E2
αプレーン
10
元画像
ぼかし画像
α合成
(αブレンディング等)
E3

[Drawing 3]

(A) 元画像



(B) ぼかし画像



[Drawing 14]

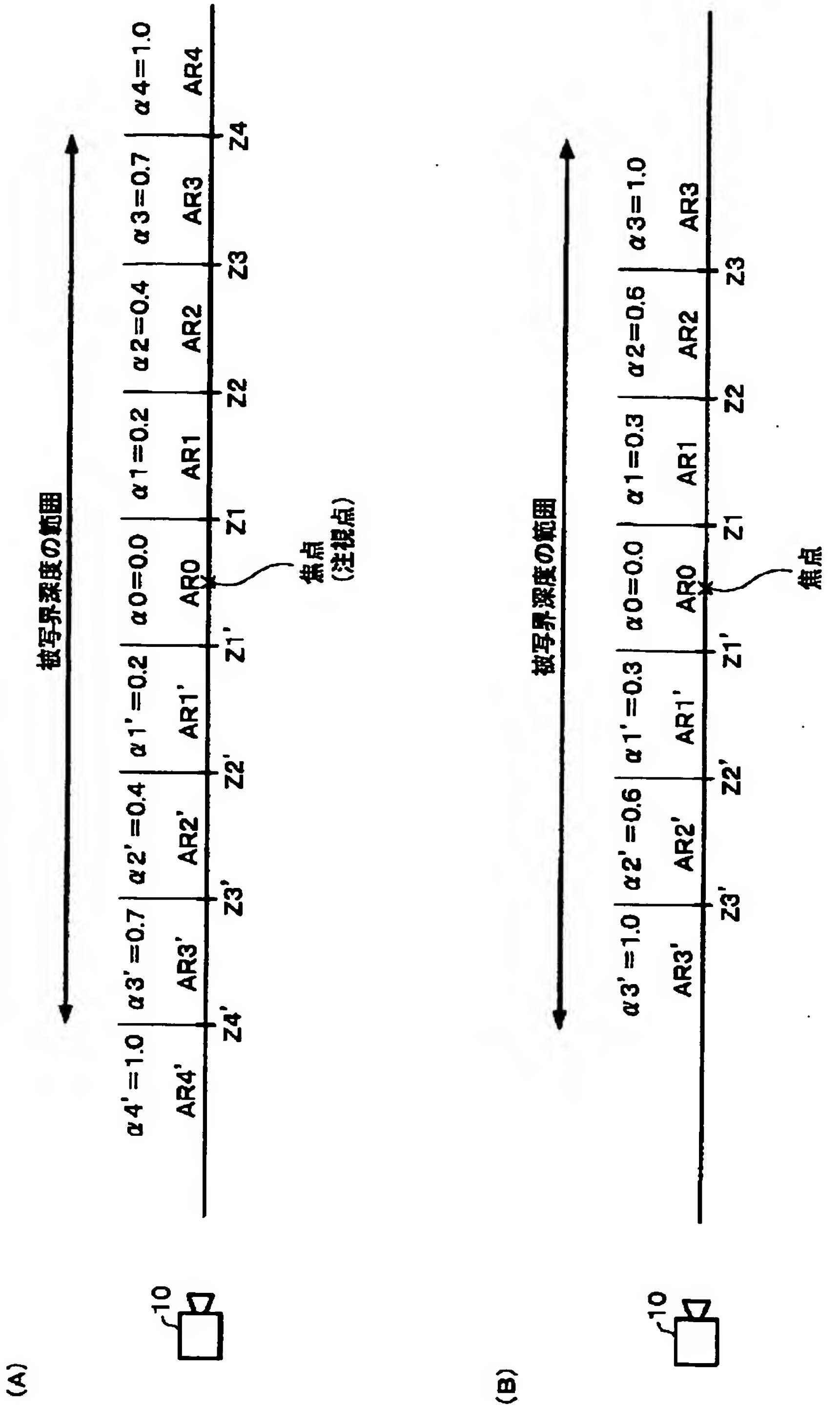
(A)

	$\frac{1}{16}$	$\frac{2}{16}$	$\frac{1}{16}$	
	$\frac{2}{16}$	$\frac{4}{16}$	$\frac{2}{16}$	
	$\frac{1}{16}$	$\frac{2}{16}$	$\frac{1}{16}$	

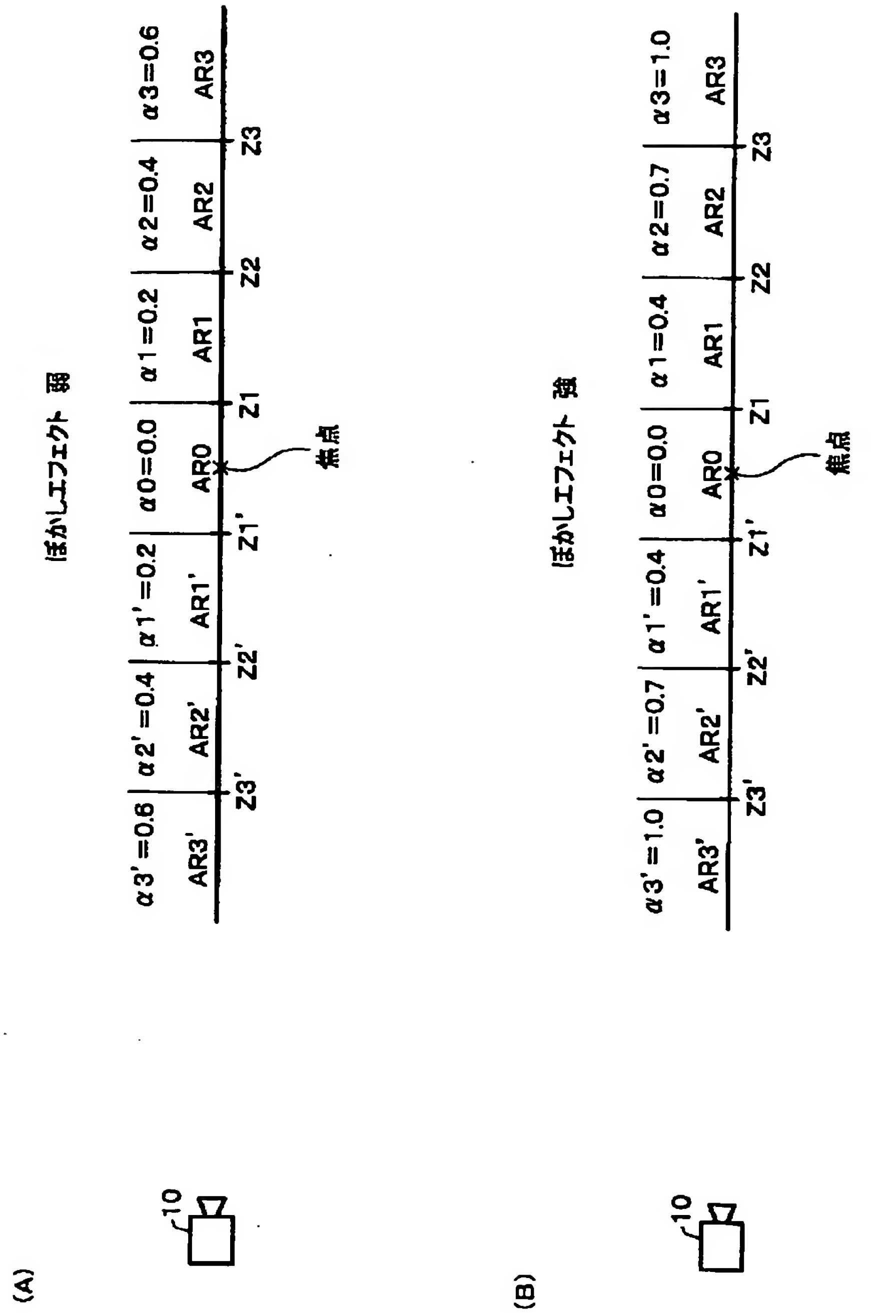
(B)

$\frac{1}{256}$	$\frac{4}{256}$	$\frac{6}{256}$	$\frac{4}{256}$	$\frac{1}{256}$
$\frac{4}{256}$	$\frac{16}{256}$	$\frac{24}{256}$	$\frac{16}{256}$	$\frac{4}{256}$
$\frac{6}{256}$	$\frac{24}{256}$	$\frac{36}{256}$	$\frac{24}{256}$	$\frac{6}{256}$
$\frac{4}{256}$	$\frac{16}{256}$	$\frac{24}{256}$	$\frac{16}{256}$	$\frac{4}{256}$
$\frac{1}{256}$	$\frac{4}{256}$	$\frac{6}{256}$	$\frac{4}{256}$	$\frac{1}{256}$

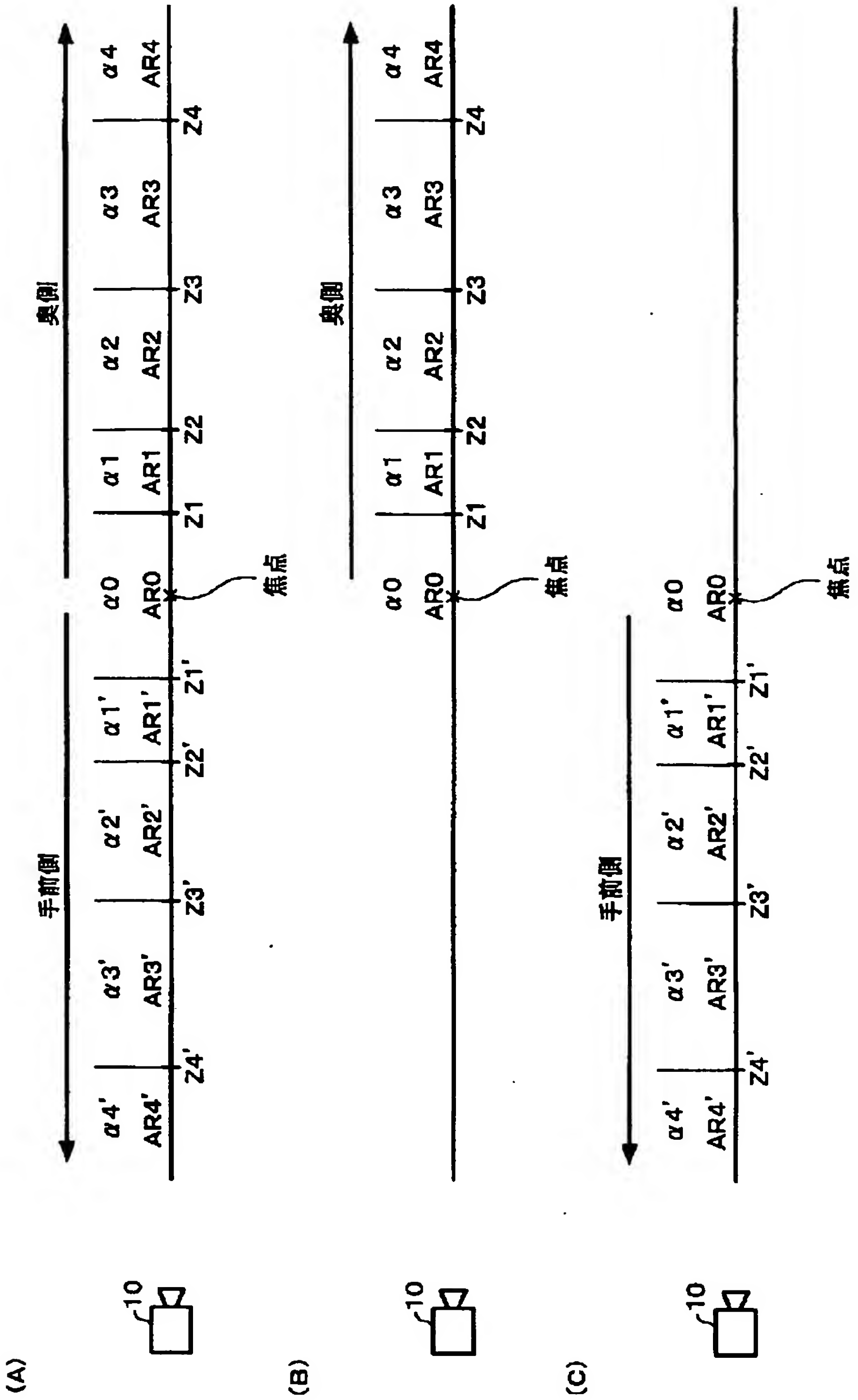
[Drawing 4]


(A)
被写界深度の範囲
α4=1.0
AR4
Z4
α3=0.7
AR3
Z3
α2=0.4
AR2
Z2
α1=0.2
AR1
Z1
α0=0.0
AR0
焦点
(注視点)
Z1'
α1'=0.2
AR1'
Z2'
α2'=0.4
AR2'
Z3'
α3'=0.7
AR3'
Z4'
α4'=1.0
AR4'
10
(B)
被写界深度の範囲
α3=1.0
AR3
Z3
α2=0.6
AR2
Z2
α1=0.3
AR1
Z1
α0=0.0
AR0
焦点
Z1'
α1'=0.3
AR1'
Z2'
α2'=0.6
AR2'
Z3'
α3'=1.0
AR3'
10

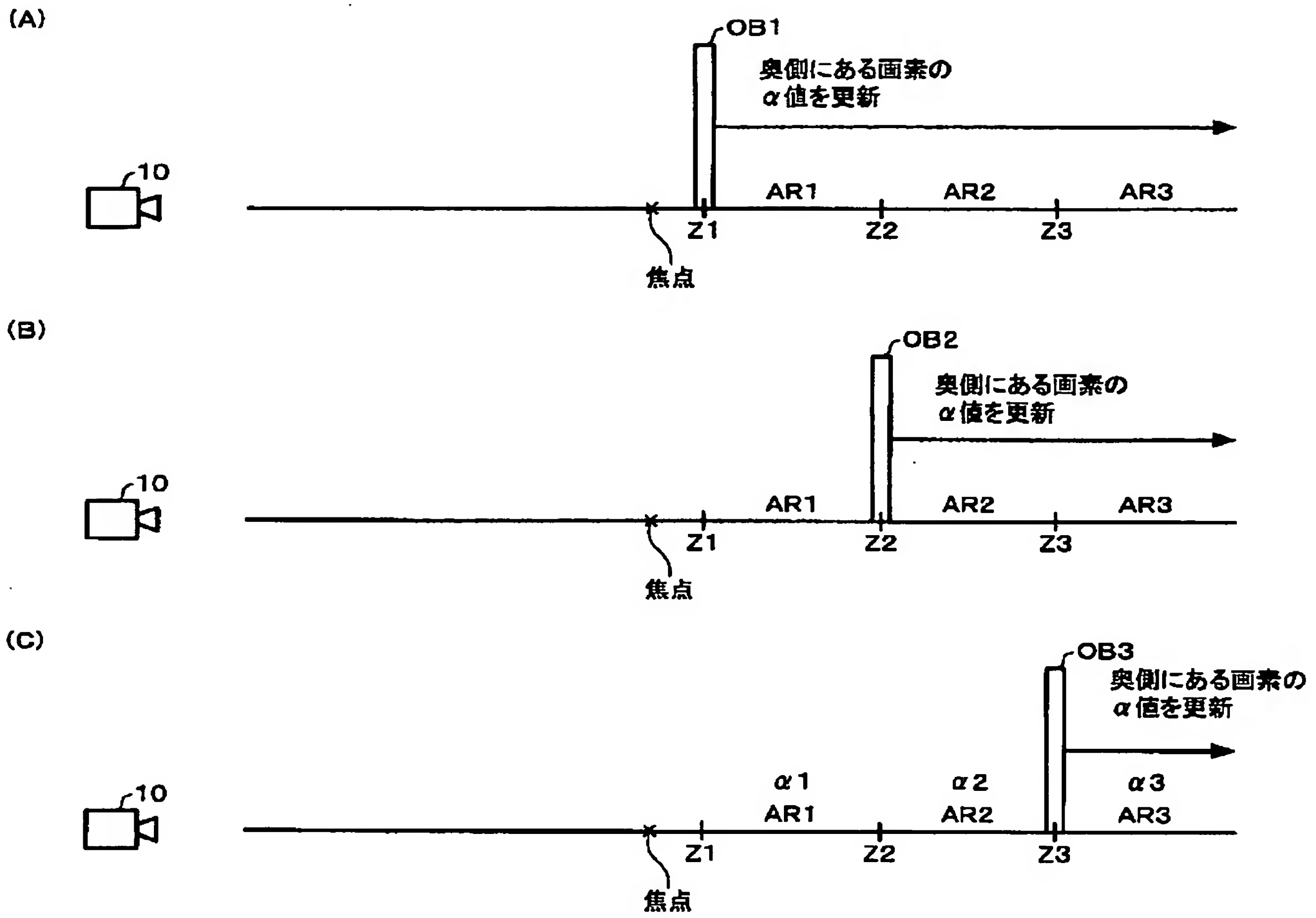
[Drawing 5]


(A)
ぼかしエフェクト 弱
α3'=0.6
AR3'
Z3'
α2'=0.4
AR2'
Z2'
α1'=0.2
AR1'
Z1'
α0=0.0
AR0
焦点
Z1
α1=0.2
AR1
Z2
α2=0.4
AR2
Z3
α3=0.6
AR3
10
(B)
ぼかしエフェクト 強
α3'=1.0
AR3'
Z3'
α2'=0.7
AR2'
Z2'
α1'=0.4
AR1'
Z1'
α0=0.0
AR0
焦点
Z1
α1=0.4
AR1
Z2
α2=0.7
AR2
Z3
α3=1.0
AR3
10

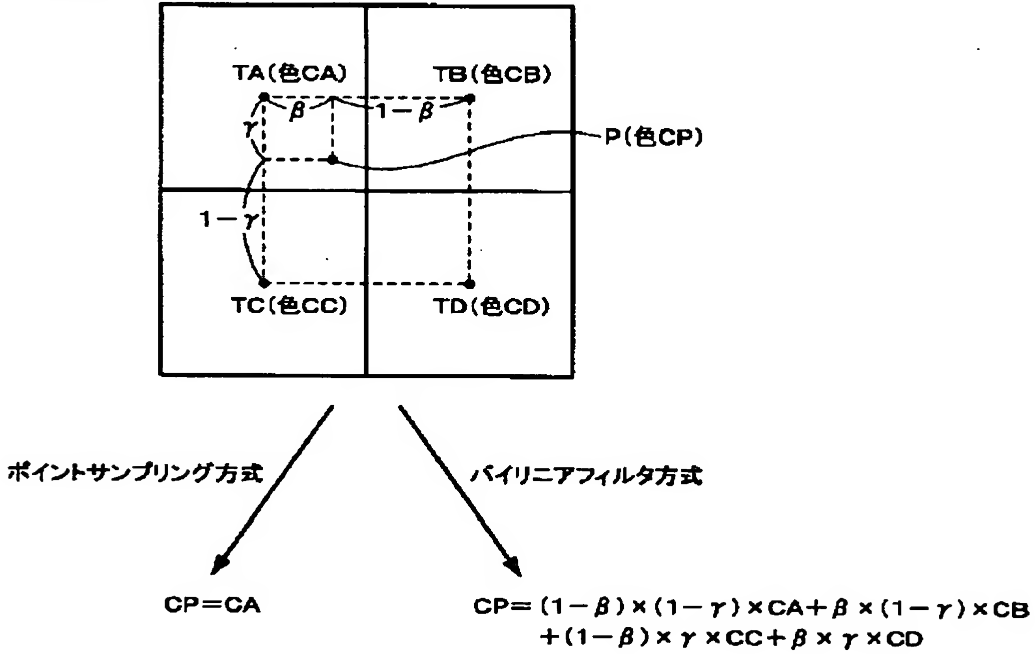
[Drawing 6]


(A)
(B)
(C)
奥側
手前側
焦点
α0
α1
α2
α3
α4
α1'
α2'
α3'
α4'
AR0
AR1
AR2
AR3
AR4
AR1'
AR2'
AR3'
AR4'
Z1
Z2
Z3
Z4
Z1'
Z2'
Z3'
Z4'
10

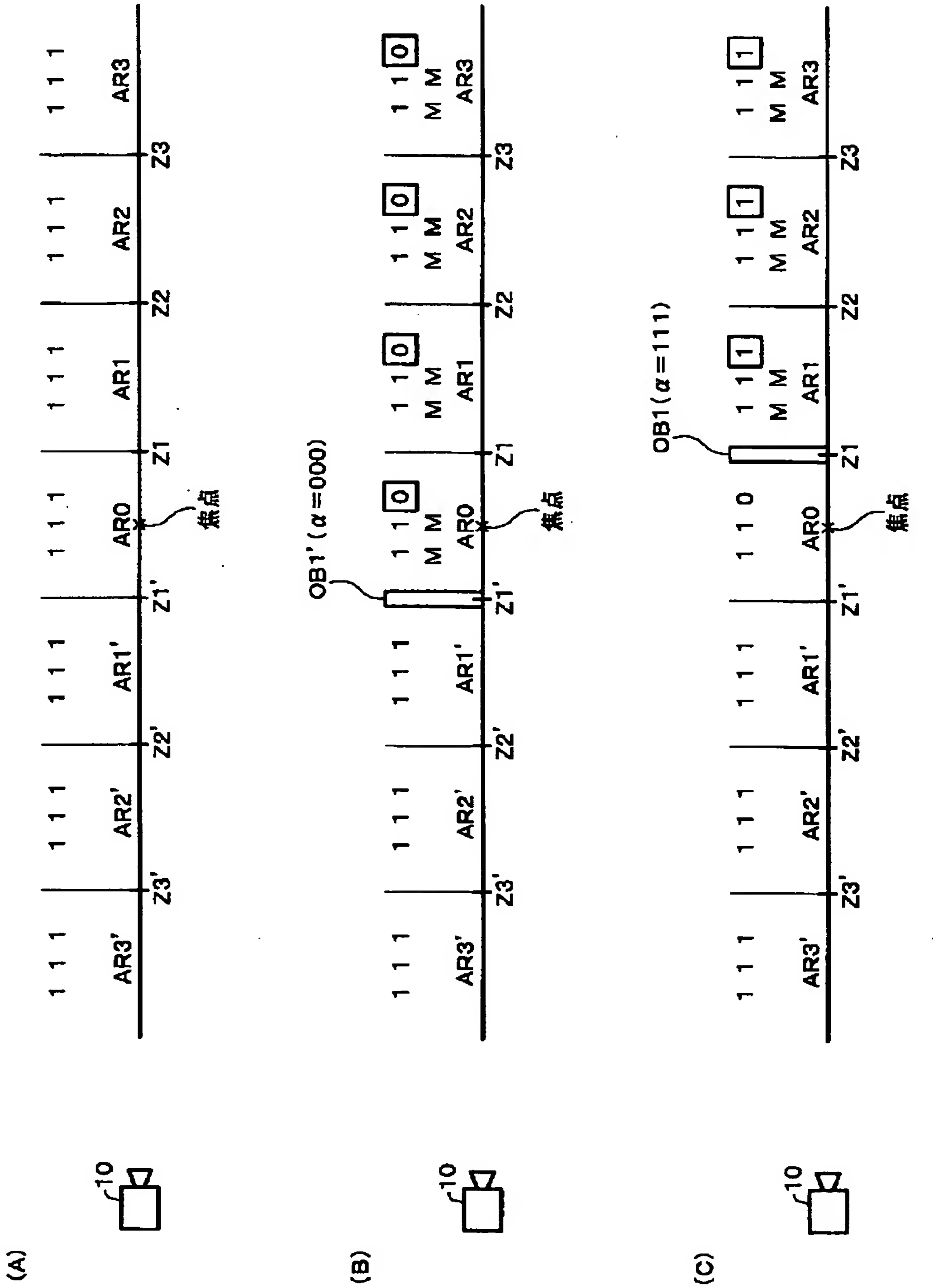
[Drawing 7]


(A)
OB1
奥側にある画素の
α値を更新
10
AR1
AR2
AR3
Z1
Z2
Z3
焦点
(B)
OB2
奥側にある画素の
α値を更新
10
AR1
AR2
AR3
Z1
Z2
Z3
焦点
(C)
OB3
奥側にある画素の
α値を更新
10
α1
α2
α3
AR1
AR2
AR3
Z1
Z2
Z3
焦点

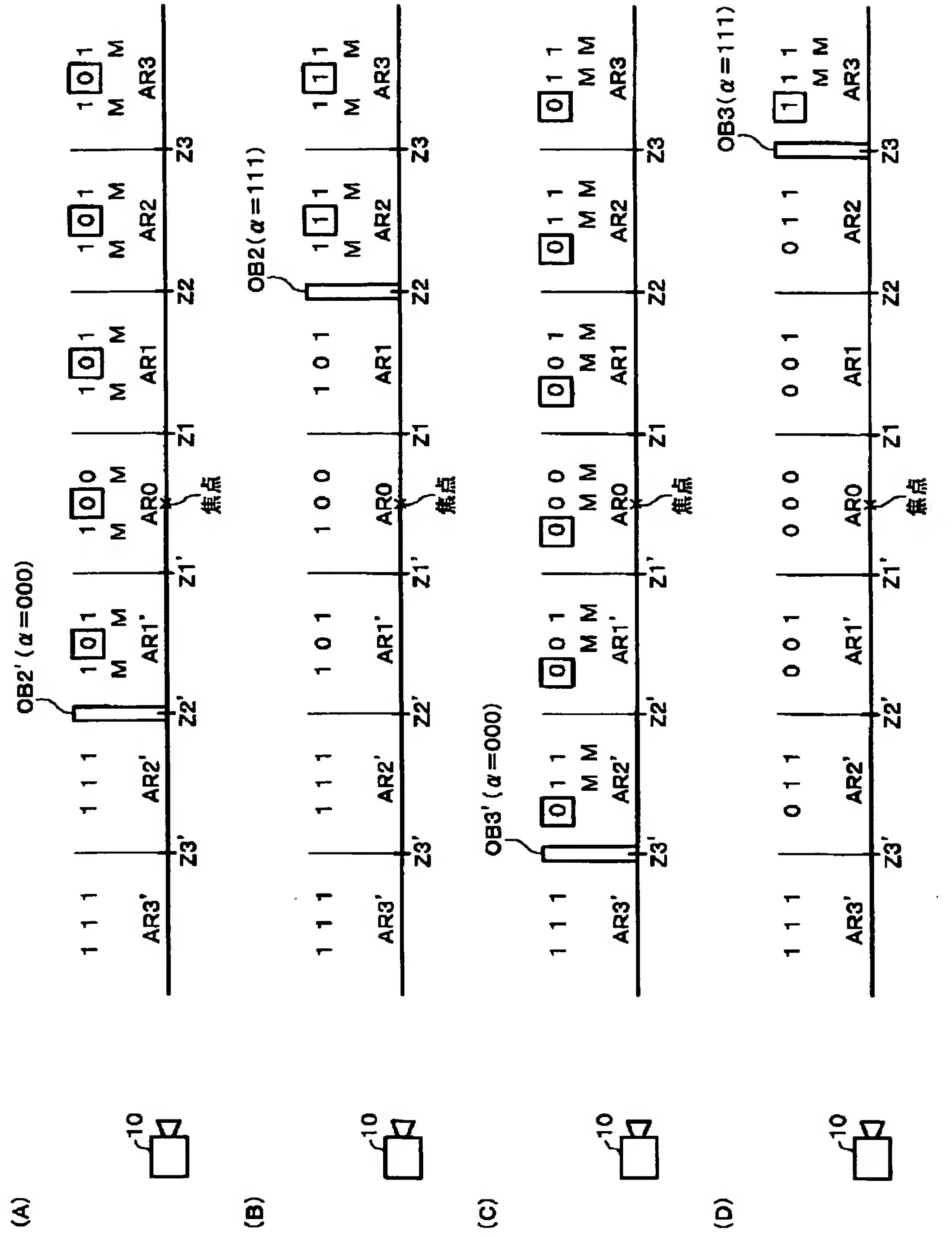
[Drawing 10]


TA(色CA)
TB(色CB)
β
1－β
γ
1－γ
P(色CP)
TC(色CC)
TD(色CD)
ポイントサンプリング方式
バイリニアフィルタ方式
CP=CA
CP=(1－β)×(1－γ)×CA+β×(1－γ)×CB
+(1－β)×γ×CC+β×γ×CD

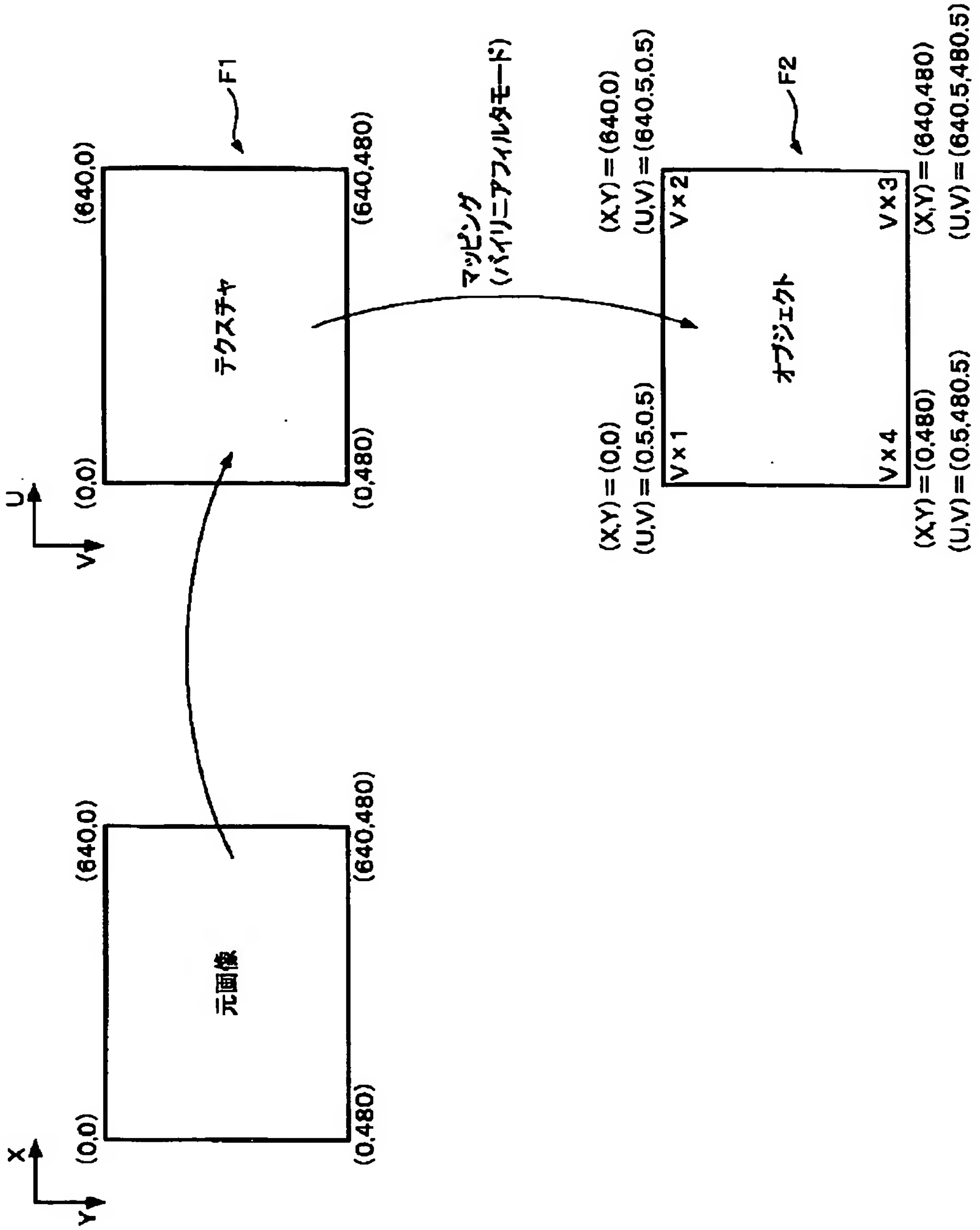
[Drawing 8]


(A)
(B)
(C)
10
1 1 1
AR3
Z3
AR2
Z2
AR1
Z1
AR0
焦点
Z1'
AR1'
Z2'
AR2'
Z3'
AR3'
M M
1 1 0
OB1'(α=000)
OB1(α=111)

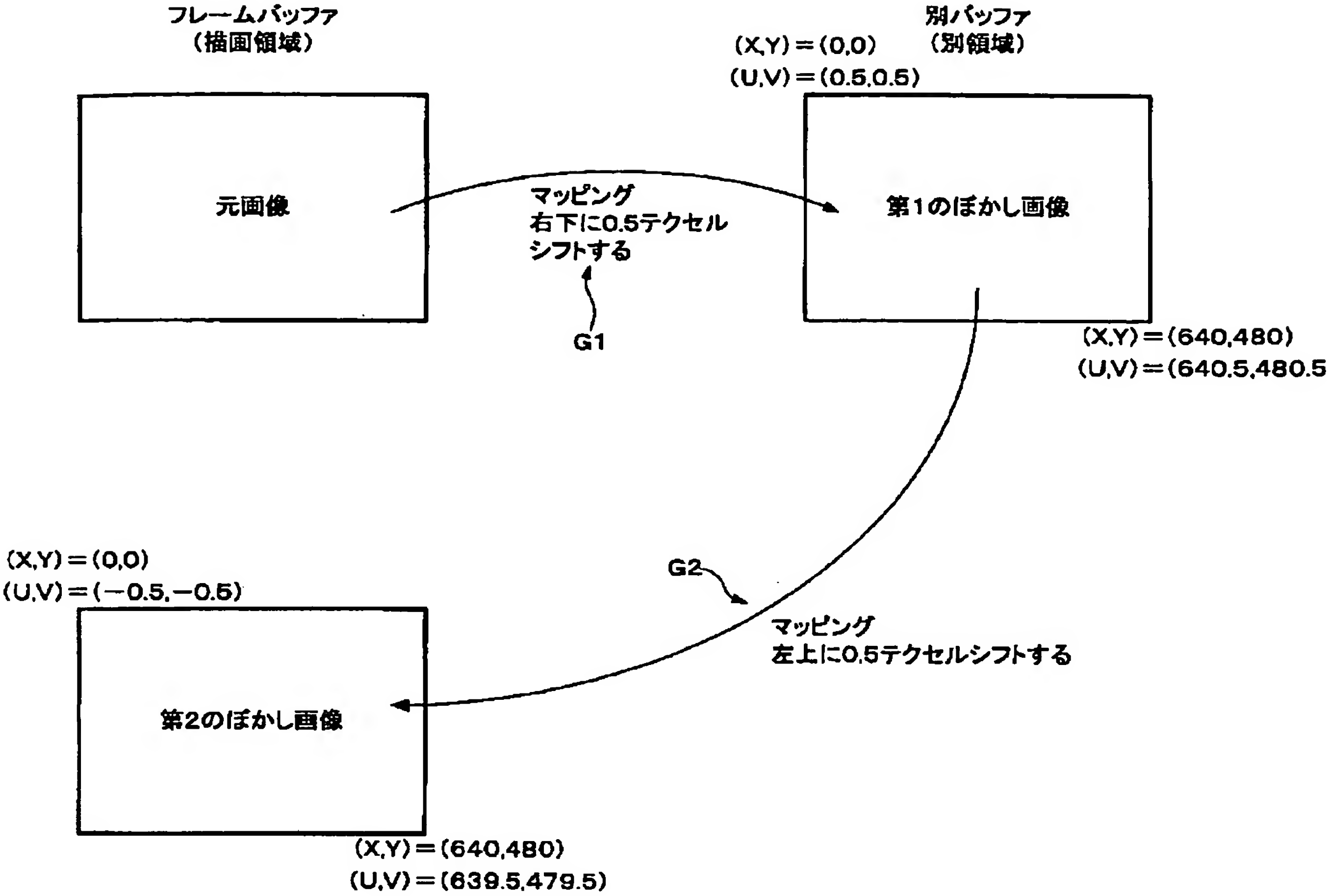
[Drawing 9]


(A)
(B)
(C)
(D)
10
OB2'(α=000)
OB2(α=111)
OB3'(α=000)
OB3(α=111)
AR3'
AR2'
AR1'
AR0
AR1
AR2
AR3
Z3'
Z2'
Z1'
Z1
Z2
Z3
焦点
M
1 1 1
1 0 1
1 0 0
0 1 1
0 0 1
0 0 0

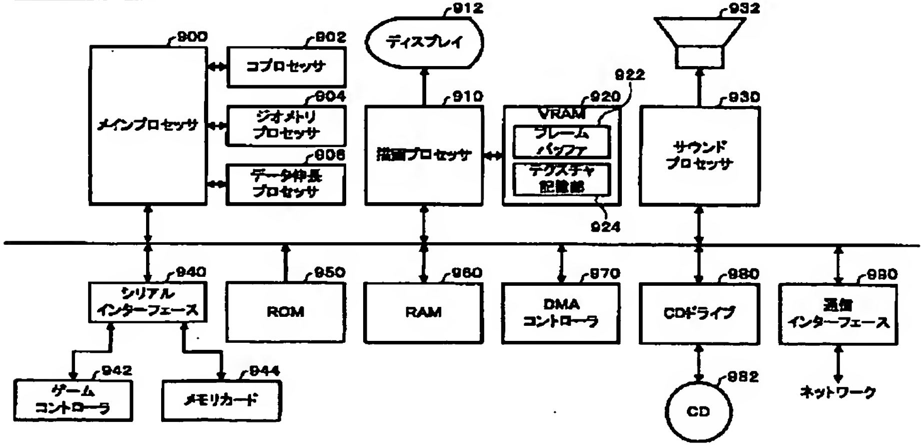
[Drawing 11]


元画像
X
Y
(0,0)
(640,0)
(640,480)
(0,480)
テクスチャ
U
V
(0,0)
(640,0)
(640,480)
(0,480)
F1
マッピング
(バイリニアフィルタモード)
オブジェクト
F2
Vx1
Vx2
Vx3
Vx4
(X,Y)=(0,0)
(U,V)=(0.5,0.5)
(X,Y)=(640,0)
(U,V)=(640.5,0.5)
(X,Y)=(640,480)
(U,V)=(640.5,480.5)
(X,Y)=(0,480)
(U,V)=(0.5,480.5)

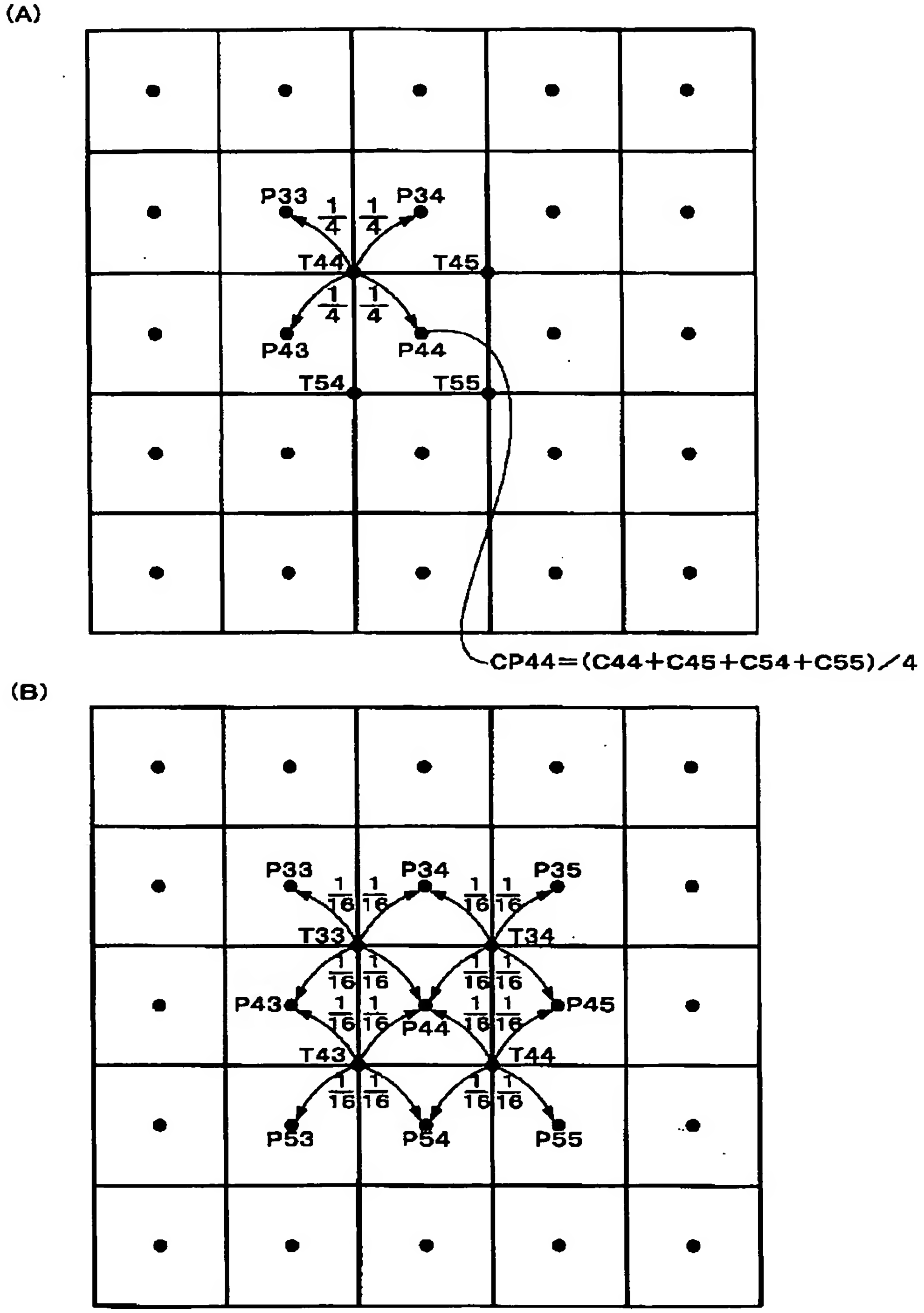
[Drawing 12]


フレームバッファ
（描画領域）
別バッファ
（別領域）
(X,Y)＝(0,0)
(U,V)＝(0.5,0.5)
元画像
マッピング
右下に0.5テクセル
シフトする
G1
第1のぼかし画像
(X,Y)＝(640,480)
(U,V)＝(640.5,480.5
(X,Y)＝(0,0)
(U,V)＝(−0.5,−0.5)
G2
マッピング
左上に0.5テクセルシフトする
第2のぼかし画像
(X,Y)＝(640,480)
(U,V)＝(639.5,479.5)

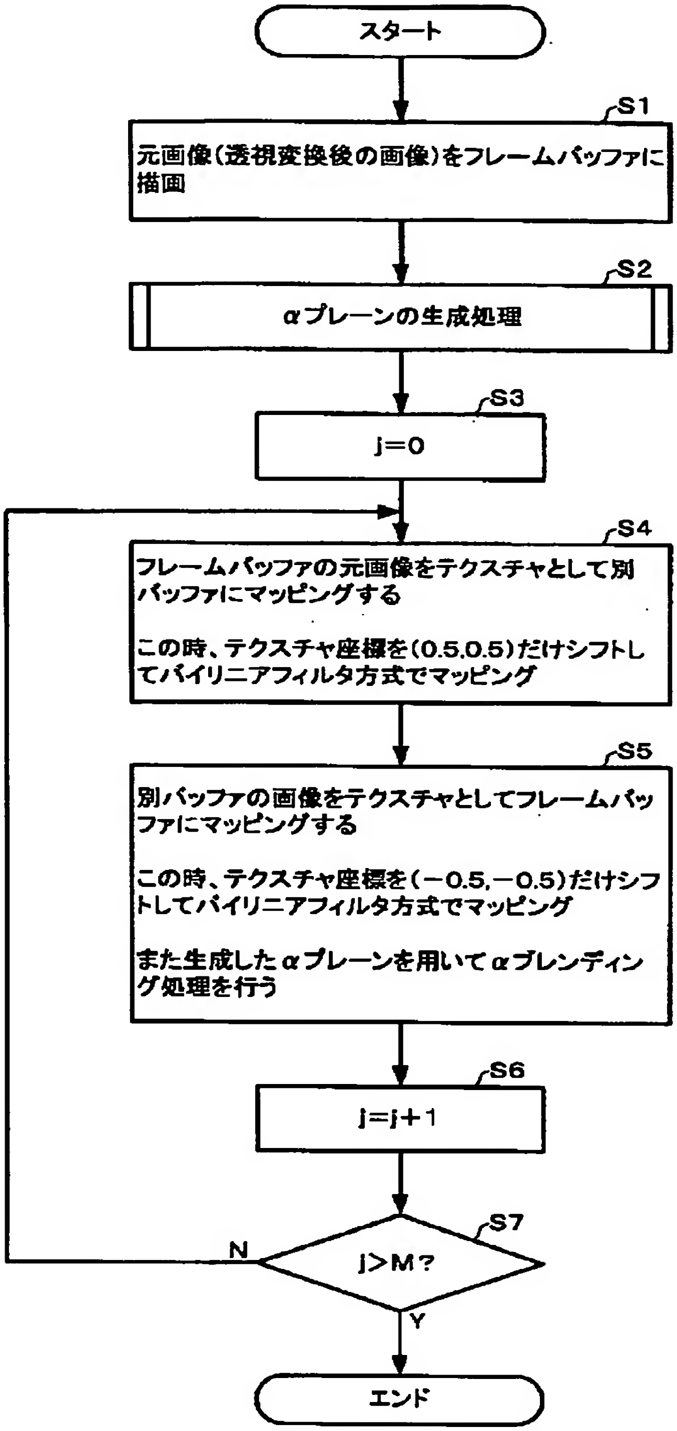
[Drawing 17]


900
メインプロセッサ
902
コプロセッサ
904
ジオメトリ
プロセッサ
906
データ伸長
プロセッサ
912
ディスプレイ
910
描画プロセッサ
922
920
VRAM
フレーム
バッファ
テクスチャ
記憶部
924
932
930
サウンド
プロセッサ
940
シリアル
インターフェース
950
ROM
960
RAM
970
DMA
コントローラ
980
CDドライブ
990
通信
インターフェース
942
ゲーム
コントローラ
944
メモリカード
982
CD
ネットワーク

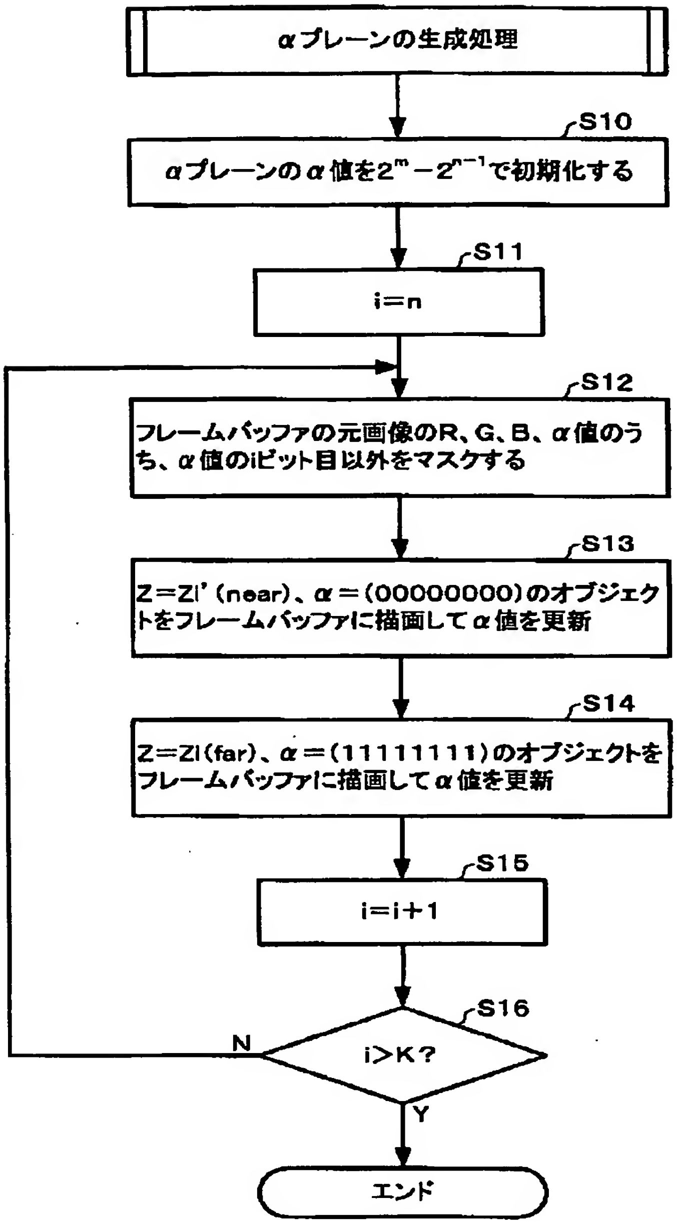
[Drawing 13]


(A)
P33
P34
1/4
1/4
1/4
1/4
T44
T45
P43
P44
T54
T55
CP44=(C44+C45+C54+C55)／4
(B)
P33
P34
P35
1/16
T33
T34
P43
P44
P45
T43
T44
P53
P54
P55

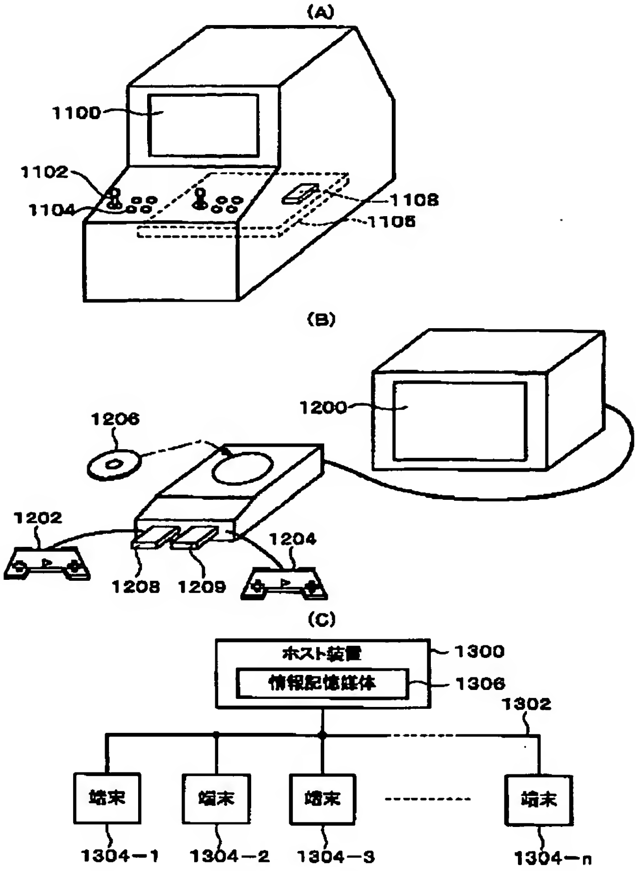
[Drawing 15]


スタート
S1
元画像（透視変換後の画像）をフレームバッファに描画
S2
αプレーンの生成処理
S3
j=0
S4
フレームバッファの元画像をテクスチャとして別バッファにマッピングする
この時、テクスチャ座標を(0.5,0.5)だけシフトしてバイリニアフィルタ方式でマッピング
S5
別バッファの画像をテクスチャとしてフレームバッファにマッピングする
この時、テクスチャ座標を(−0.5,−0.5)だけシフトしてバイリニアフィルタ方式でマッピング
また生成したαプレーンを用いてαブレンディング処理を行う
S6
j=j+1
S7
j>M?
N
Y
エンド

[Drawing 16]


αプレーンの生成処理
S10
αプレーンのα値を2^m-2^{n-1}で初期化する
S11
i=n
S12
フレームバッファの元画像のR、G、B、α値のうち、α値のiビット目以外をマスクする
S13
Z=Zi'(near)、α=(00000000)のオブジェクトをフレームバッファに描画してα値を更新
S14
Z=Zi(far)、α=(11111111)のオブジェクトをフレームバッファに描画してα値を更新
S15
i=i+1
S16
i>K?
N
Y
エンド

[Drawing 18]


(A)
1100
1102
1104
1108
1106
(B)
1206
1200
1202
1204
1208
1209
(C)
ホスト装置
1300
情報記憶媒体
1306
1302
端末
端末
端末
端末
1304−1
1304−2
1304−3
1304−n

[Translation done.]